

ELECTRIC POWER
IN CANADA 1988



Canada

THE ENERGY OF OUR RESOURCES

THE POWER OF OUR IDEAS

ELECTRIC POWER IN CANADA 1988

Electrical Energy Branch
Energy Sector
Energy, Mines and Resources Canada

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1. THE ELECTRIC POWER INDUSTRY IN CANADA

INDUSTRY STRUCTURE

Under the Canadian Constitution, electricity is primarily within the jurisdiction of the provinces. As a consequence, Canada's electrical industry is organized along provincial lines. In most provinces, the industry is highly integrated, with the bulk of the generation, transmission, and distribution provided by a few dominant utilities. Although some of these utilities are privately owned, most are Crown corporations owned by the provinces. The dominant utilities are listed in Table 1.1.

Among the major electric utilities, eight are provincially owned, four are investor owned, two are municipally owned, and two are territorial Crown corporations. In 1988, provincial electric utilities owned about 85.1 per cent of total installed generating capacity and produced about 82.5 per cent of total generated electricity. The four investor-owned utilities accounted for 5.8 per cent of all Canadian electric utility capacity and produced about 7.4 per cent of total electricity. Municipally owned utilities accounted for 1.2 per cent of capacity ownership, and produced 0.5 per cent of total generated electricity; two territorial Crown corporations accounted for 0.3 per cent and 0.2 per cent of capacity and generation respectively.

In addition to the 16 major electric utilities, there are about 60 industrial establishments generating electricity mainly for their own use. A few also sell energy to municipal distribution systems or utilities. These

Table 1.1. Canada's major electric utilities by province

Province	Utility	Ownership
Newfoundland	Newfoundland and Labrador Hydro	Provincial
	Newfoundland Light & Power Co. Ltd.	Private
Prince Edward Island	Maritime Electric Co. Ltd.	Private
Nova Scotia	Nova Scotia Power Corporation	Provincial
New Brunswick	New Brunswick Electric Power Commission	Provincial
Quebec	Hydro-Québec	Provincial
Ontario	Ontario Hydro	Provincial
Manitoba	The Manitoba Hydro-Electric Board	Provincial
	City of Winnipeg Hydro-Electric System	Municipal
Saskatchewan	Saskatchewan Power Corporation	Provincial
Alberta	Alberta Power Ltd.	Private
	Edmonton Power	Municipal
	TransAlta Utilities Corporation	Private
British Columbia	British Columbia Hydro and Power Authority	Provincial
Yukon	Yukon Energy Corporation	Territorial
Northwest Territories	Northwest Territories Power Corporation	Territorial

Source: *Energy, Mines and Resources Canada*.

industries are concentrated in the pulp and paper, mining, and aluminum smelting sectors. In 1980, industrial establishments owned about 6.1 per cent of total capacity and produced about 7.8 per cent of total generated electricity in Canada, as shown in Table 1.2.

In addition to the major electric utilities and industrial establishments, there are about 364 smaller utilities across Canada, 87 per cent of which are located in Ontario. Most of these small utilities are owned by municipalities. They do not own generating capacity; instead, they usually purchase power from the

major utility in their province. Several small investor-owned utilities, however, have their own generating capacity. In 1988, the small utilities accounted for 1.5 per cent of total Canadian capacity and produced 1.6 per cent of electrical energy.

ELECTRICITY AND THE ECONOMY

The electric power industry is a significant presence within the Canadian economy. As indicated in Table 1.3, there were almost 93 000 people directly employed by the industry in 1987, about 0.9 per cent of total Canadian

employment. Total revenue increased to about \$18.6 billion in 1987 from \$17.4 billion in 1986, an increase of 6.9 per cent. Of this total, approximately \$0.9 billion or 4.8 per cent came from export earnings. The electric power industry has steadily increased its contribution to Canada's Gross Domestic Product, from 2.3 per cent in 1960, to 2.5 per cent in 1970, to 3.0 per cent in 1980, and 3.2 per cent in 1987.

Total assets of the industry were about \$98.7 billion in 1987, accounting for about 7 per cent of the capital stock of the economy. This reflects the capital-intensive nature of the electric power industry. Ontario Hydro, Hydro-Québec, and B.C. Hydro were the three largest electric utilities in Canada and, in terms of assets, ranked first, second, and sixth respectively among all Canadian companies.

Table 1.2. Electrical capacity and production by utilities and industrial establishments, 1930-1988

Year	Installed Generating Capacity		Energy Production	
	Utilities	Industrial Establishments	Utilities	Industrial Establishments
	(per cent)			
1930	83	17	93	7
1940	84	16	91	9
1950	83	17	88	12
1960	80	20	78	22
1965	82	18	77	23
1970	88	12	84	16
1975	90	10	87	13
1980	92	8	89	11
1981	92	8	90	10
1982	93	7	90	10
1983	93	7	90	10
1984	93	7	91	9
1985	93	7	92	8
1986	94	6	92	8
1987	94	6	91	9
1988	94	6	92	8

Source: *Electric Power Statistics, Volume II, Statistics Canada, 57-202, 57-001.*

CANADIAN ELECTRIC UTILITIES

Newfoundland

In Newfoundland, the generation and distribution of electricity is dominated by two utilities, Newfoundland Light & Power Company Limited (NLPC) and Newfoundland and Labrador Hydro (NLH). Together, NLPC and NLH serve about 200 000 customers.

NLPC, an investor-owned utility, is the primary retailer of electricity on the island. NLPC was incorporated in 1966 through the amalgamation of St. John's Electric Light Company Limited, United Towns Electric Company Limited, and Union Electric Light and Power Company.

Approximately 89 per cent of the company's power supply is purchased from NLH, with the balance generated by its own hydro stations.

NLH is a provincial Crown corporation, whose mandate is to generate and transmit electricity in the province. It was established by an act of the provincial legislature in 1954 and

was incorporated in 1975. It is the parent company of a group that includes Churchill Falls (Labrador) Corporation (CFLCo), the Lower Churchill Development Corporation

Table 1.3. Electric utility assets, revenue and employees, 1987

Utility	Assets (\$ millions)	Revenue	Employees (persons)
Major utilities			
Newfoundland and Labrador Hydro	2 147	332	1 355
Newfoundland Light & Power Co. Ltd.	390	251	914
Maritime Electric Co. Ltd.	93	61	202
Nova Scotia Power Corporation	1 509	510	2 420
NB Electric Power Commission	2 846	867	2 410
Hydro-Québec	31 659	5 095	22 264
Ontario Hydro	32 657	5 280	32 147
The Manitoba Hydro-Electric Board	3 832	580	4 222
City of Winnipeg Hydro-Electric System	123	92	648
Saskatchewan Power Corporation*	2 939	859	2 881
TransAlta Utilities	3 684	925	2 515
Edmonton Power	1 129	280	913
Alberta Power Ltd.	1 414	409	1 393
B.C. Hydro and Power Authority*	9 561	2 110	6 419
Yukon Energy Corporation	95	26	86
Northern Canada Power Commission	138	76	354
Other utilities	4 465	865	11 644
Canada	98 681	18 618	92 787

* Includes natural gas operations

Source: Electric utilities' annual reports

(LCDC), Twin Falls Power Corporation Limited, Gull Island Power Co. Ltd., and the Power Distribution District of Newfoundland and Labrador. NLH has 51 per cent ownership in LCDC; the Government of Canada owns the remaining 49 per cent. Through CFLCo, NLH owns and operates the Churchill Falls plant, one of the largest power facilities in the world. NLH's on-island capacity is generated from oil and hydro sources.

Prince Edward Island

Maritime Electric Company Limited (MECL) is an investor-owned utility that has provided electricity service to Prince Edward Island since 1918. The company owns and operates a fully integrated electric utility system providing for the generation, transmission, and distribution of electricity throughout the island. MECL operates two oil-fired generating plants on the island, and it has a 10 per cent equity interest in New Brunswick Electric Power Commission's coal/oil-fired No. 2 unit located in Dalhousie, N.B. It leases from the P.E.I. government the submarine cable interconnection that connects the island to New Brunswick. MECL is the major distributor on the island, serving about 48 600 customers. A municipal utility in the town of Summerside has its own distribution system and purchases power from MECL.

Nova Scotia

The Nova Scotia Power Corporation (NSPC) was incorporated in 1973. It is a provincial Crown corporation that produces and distributes electricity throughout the province. NSPC generates most of its electricity from thermal energy, with more than half of the production coming from coal. The utility also maintains hydro-generation and oil-fired facilities, and purchases power from New Brunswick. The largest portion of the province's total production is derived from the Lingan generating station located on Cape Breton Island. In 1988, NSPC served about 350 000 customers.

New Brunswick

The New Brunswick Electric Power Commission (NB Power) was established by an act of the New Brunswick Legislature in 1920. The mandate of NB Power is to generate and distribute power under public ownership to all areas of the province. The utility owns and operates 14 generating stations, and electricity is generated from a balance of nuclear, hydro, and thermal sources. NB Power also purchases energy from Quebec. In 1988, NB Power directly provided electricity to 253 000 customers and indirectly served an additional 39 000 customers through sales to two municipal utilities.

Quebec

Hydro-Québec is a Crown corporation, established by the provincial Legislative Assembly in 1944. It is responsible for the generation, transmission, and distribution of most of the electricity sold in Quebec. Almost all of the electricity generated by Hydro-Québec at its stations throughout the province is from hydraulic sources. The utility currently serves more than 3.0 million customers.

Hydro-Québec has five wholly owned subsidiaries: the Société d'énergie de la Baie James, which carried out the construction of Phase 1 of La Grande complex and which now manages large construction projects for Hydro-Québec; Hydro-Québec International, which provides engineering and consulting services abroad for electric power projects; Cedars Rapids Transmission Company Limited, which owns and operates a transmission line between Quebec and New York State; Somarex Inc., which was created to finance, construct, and operate a transmission line in the State of Maine; and Nouveler Inc., which promotes energy efficiency and alternative energy sources. Hydro-Québec is also a shareholder in Churchill Falls (Labrador) Corporation Limited, which operates the Churchill Falls power plant.

Ontario

Ontario Hydro is a provincially owned corporation, established in 1906 by the provincial legislature. It has broad powers to produce, buy, and deliver electric power throughout the province and currently operates under the Power Corporation Act. The main responsibility of Ontario Hydro is to provide power to the province's 316 municipal utilities, which in turn distribute power to their own customers. In 1988, more than 3.3 million customers were served by Ontario Hydro and the municipal utilities in the province. In addition, Ontario Hydro supplies about 100 major industrial users directly and over 800 000 rural retail customers in areas or communities not served by municipal utilities. Electricity generated by Ontario Hydro is from a balance of thermal, nuclear, and hydro sources.

In Ontario, there are also a number of small regional utilities. An example is Great Lakes Power Limited, a private hydroelectric generation and distribution utility operating in Sault Ste. Marie and the surrounding area. Great Lakes Power operates nine generating stations primarily located on two river systems flowing into the eastern end of Lake Superior, and is now developing additional capacity on the Magpie River. In 1988, the utility served almost 10 000 customers in northern Ontario directly, and another 30 000 indirectly.

Manitoba

The Manitoba Hydro-Electric Board (Manitoba Hydro) is a

Crown corporation established in 1949 by the provincial legislature. It has broad powers to provide electric power throughout the province and operates under the 1970 Manitoba Hydro Act. Almost all of the province's electric power is produced by Manitoba Hydro at its generating stations on the Churchill/Nelson river system in northern Manitoba. Manitoba Hydro distributes electricity to consumers throughout the province, except for the central portion of Winnipeg, which is served by the municipally owned Winnipeg Hydro. Manitoba Hydro and Winnipeg Hydro operate as an integrated electrical generation and transmission system. In 1988, Manitoba Hydro served over 360 000 customers directly, and Winnipeg Hydro served about 113 000 customers.

Saskatchewan

The Saskatchewan Power Corporation (SaskPower) is a Crown corporation operating under the 1950 Power Corporation Act. Under the Act, the mandate of SaskPower includes the generation, transmission, and distribution of electricity and natural gas. At the end of 1988, the corporation served more than 400 000 customers with electricity. The bulk of the electricity generated by SaskPower is from thermal sources.

In 1988, the gas operations of the corporation became separate companies within SaskPower. The parent company of the gas operations is the Saskatchewan Energy Corporation (SaskEnergy). Its subsidiaries are TransGas Limited and Provincial

Gas Ltd. In 1988, SaskEnergy served more than 280 000 customers with natural gas.

Alberta

There are three major electric utilities in Alberta: TransAlta Utilities Corporation, Alberta Power Limited, and Edmonton Power. Together, they supply about 91 per cent of Alberta's electrical energy requirements. All are linked by a transmission network largely owned by TransAlta. The remaining 9 per cent of Alberta's electrical energy is supplied by industry. Almost 92 per cent of the electricity generated by Alberta utilities is produced by large coal-fired generating stations.

TransAlta Utilities Corporation, formerly Calgary Power Limited, is the largest investor-owned electric utility in Canada. The company was incorporated under the laws of Canada and has been engaged in the production and distribution of electricity in the Province of Alberta since 1911. About 71 per cent of the electric energy requirements of Alberta are supplied by the company, to over half of the population. In 1988, about 290 000 customers were served directly by TransAlta, while another 300 000 customers were served indirectly through wholesale contracts. TransAlta Utilities has four subsidiaries: TransAlta Resources Corporation; TransAlta Fly Ash Ltd.; Kanelk Transmission Co. Ltd.; and Farm Electric Services Ltd.

Alberta Power Limited, incorporated in 1972, is another investor-owned electric utility in

Alberta, and a subsidiary of Canadian Utilities Limited. The activity of the company is concentrated in east-central and northern Alberta. Alberta Power supplied about 19 per cent of the province's total electricity requirements in 1988, serving about 150 000 customers.

Edmonton Power has the largest generating capacity of any municipally owned utility in Canada. Since its creation in 1902, Edmonton Power has kept pace with the growth and development of Edmonton. Although the utility produced only 1.4 per cent of the electricity requirements of Alberta, it had a 15 per cent share of the total provincial market in 1988, serving more than 235 000 customers. Edmonton Power purchases most of its electricity from TransAlta Utilities and Alberta Power.

British Columbia

British Columbia Hydro & Power Authority (B.C. Hydro), incorporated in 1962, is a Crown corporation operating in British Columbia. B.C. Hydro provides electrical service throughout the province, with the exception of the southern interior, which is served by West Kootenay Power and Light Company, Limited. B.C. Hydro is the third largest electric utility in Canada. B.C. Hydro generates, transmits, and distributes electricity to more than 1.2 million customers in a service area that contains more than 90 per cent of the population of the province.

In 1988, B.C. Hydro proceeded with a corporate restructuring that resulted in the privatization

of its mainland gas operations and its rail operations. The utility also created a number of subsidiaries. The British Columbia Power Export Corporation (Powerex) will act as a provincial electricity export agency. The utility's former research and development division is now the wholly owned subsidiary Powertech Laboratories Inc. The computer and management systems division has been reorganized into two subsidiaries: Westech Information Systems Inc. and Western Integrated Technologies Inc.

West Kootenay Power is an investor-owned utility supplying electric service in the southern interior of British Columbia. The company generates and distributes hydroelectricity directly to more than 60 000 customers in its service area. The company also supplies power to seven wholesale customers, who in turn serve almost 38 000 customers. West Kootenay Power is owned by UtiliCorp United Inc. of Missouri.

Yukon

Two utilities provide electrical service in the Yukon. The largest of these, in terms of revenues and generating capacity, is the Yukon Energy Corporation. It is a territorial Crown corporation that has taken over responsibility for the Yukon assets of the Northern Canada Power Commission (NCPC). The Yukon Development Corporation (the parent corporation of the Yukon Energy Corporation) has entered into a five-year management services agreement with the Yukon Electrical Company Limited (YECL). Under the

terms of the agreement, YECL will operate the Yukon Energy Corporation's assets, purchase the electricity generated, and distribute it to the Energy Corporation's customers. The Energy Corporation's customers include all of the Yukon's major industries and 13 per cent of the Yukon's non-industrial customers.

In addition to its responsibilities to the Yukon Energy Corporation, YECL (a subsidiary of Canadian Utilities Limited) also generates and distributes power to its own customers. YECL serves 18 communities in the Yukon, including Whitehorse. It purchases the majority of its electrical requirements from the Yukon Energy Corporation.

Northwest Territories

Electrical service in the Northwest Territories is provided by the Northwest Territories Power Corporation (NWTPC) and Northland Utilities Enterprises Limited (Northland). The largest of these, in terms of revenues and generating capacity, is the NWTPC. It is a territorial Crown corporation, which in 1988 took over responsibility for the Northwest Territories' assets of the Northern Canada Power Commission. NWTPC provides electrical service to 51 communities in the N.W.T. and wholesales hydro-power to Northland.

Northland is an investor-owned utility and is a subsidiary of Canadian Utilities Limited. It provides electrical service to seven communities in the south-western region of the N.W.T.

2. CANADIAN ELECTRICITY IN THE INTERNATIONAL CONTEXT

Canada has a significant place in the world electric power industry. Canada is not only a world leader in long-distance electric power transmission, but also an important producer and consumer.

In 1986, Canada ranked fourth in the world both in installed generating capacity and electricity generation, next to the United States, U.S.S.R., and Japan (tables 2.1 and 2.2). Canada's total installed capacity accounted

for 4 per cent of the world total, while its production accounted for 5 per cent. In addition, Canada was the largest hydroelectric energy producer in the world in 1986 (311 TW.h.), accounting for about 15 per cent of total world hydro production (Table 2.2).

Canada's per capita electricity consumption ranked second in the world in 1986, next only to Norway (Table 2.3). Canada was one of the few developed

countries with a high electricity consumption growth rate during the period 1984-86 (Table 2.4). In general, most of the countries with high consumption growth rates were developing countries. This was largely due to the fact that many of these countries have been engaged in the industrialization of their economies and, as a result, have increased their electrical energy consumption significantly.

Table 2.1. International comparison of installed generating capacity, 1986*

Country	Conventional Thermal	Hydro	Nuclear	Geothermal	Total
	(MW)				
United States	547 111	84 152	86 548	1 633	719 444
U.S.S.R.	229 420	62 141	30 110	0	321 671
Japan	111 800	35 150	26 165	214	173 329
Canada	30 600	56 800	11 000	0	98 400
France	24 600	22 800	44 700	0	92 100
China	60 000	27 000	0	0	87 000
West Germany	57 076	6 710	18 874	3	82 660
United Kingdom	55 177	4 190	7 144	1	66 512
Italy	36 617	17 863	1 273	452	56 205
India	37 494	15 965	1 230	0	54 689
Brazil	6 390	37 702	657	0	44 749
Spain	15 102	14 431	5 546	0	35 079
Australia	26 199	7 029	0	250	33 478
Sweden	7 634	15 813	9 648	5	33 100
Poland	27 797	1 976	0	0	29 773
South Africa	23 190	572	965	0	24 727
Mexico	17 059	6 601	0	425	24 085
Norway	254	23 418	0	0	23 672
East Germany	18 385	1 844	1 830	0	22 059
Czechoslovakia	14 614	2 897	2 860	0	20 371
World Total **	1 614 128 (65.6%)	566 823 (23.0%)	274 504 (11.2%)	4 981 (0.2%)	2 460 436 (100%)

* Includes the 20 countries with the largest electrical systems.

** Total for all 188 countries or areas listed in source reference.

Source: *Energy Statistics Yearbook, 1986, United Nations, pp.322-348.*

Canada continued to be the largest electricity exporter in 1986, accounting for 18 per cent of the total world electricity trade (Table 2.5).

In 1986, Canada surpassed Norway as the most electricity-intensive economy of all 24 OECD-member countries (Table 2.7). Tables 2.8, 2.9 and 2.10 indicate that Canada's electricity prices are highly

competitive in the residential, commercial, and industrial sectors relative to other countries. Japan's high electricity prices are due in part to a substantial appreciation in the value of the yen.

Table 2.2. International comparison of electricity generation by fuel type, 1986*

Country	Conventional Thermal	Hydro	Nuclear	Geothermal	Total
(GW.h)					
United States	1 861 601	294 594	414 038	12 277	2 582 510
U.S.S.R.	1 222 348	215 738	160 804	0	1 598 890
Japan	415 350	86 560	168 310	1 550	671 770
Canada	86 602	310 702	71 267	0	468 571
China	344 130	100 000	0	0	444 130
West Germany	270 141	16 664	119 580	0	406 386
France	40 786	60 859	241 400	0	343 045
United Kingdom	235 009	4 067	59 079	1	298 156
Brazil	18 859	182 615	144	0	201 618
India	143 788	53 764	5 022	0	202 574
Italy	136 281	41 190	8 758	2 760	188 989
Poland	136 512	3 782	0	0	140 294
Sweden	7 080	60 694	70 243	6	138 023
Spain	63 953	26 314	37 446	0	127 713
South Africa	117 662	733	3 925	0	122 320
Australia	111 307	15 515	0	837	127 659
East Germany	102 616	1 767	10 908	0	115 291
Norway	432	95 927	0	0	96 359
Mexico	68 330	27 437	0	1 715	97 518
Czechoslovakia	62 919	3 991	17 865	0	84 775
World Total**	6 344 241 (63.7%)	2 027 100 (20.4%)	1 556 323 (15.6%)	29 600 (0.3%)	9 962 264 (100%)

* Includes the world's 20 largest electrical energy producers.

** Total for all 188 countries or areas listed in source reference.

Source: *Energy Statistics Yearbook, 1986, United Nations, pp.378-404.*

Table 2.3. International comparison of per capita electricity consumption, 1986*

Country	kW.h/Person	As Percentage of World Average
Norway	23 706	1 169
Canada	16 914	834
Iceland	16 727	824
Sweden	15 979	788
Luxembourg	11 165	551
United States	10 906	538
Finland	10 708	528
Qatar	10 642	525
New Zealand	8 411	415
Australia	8 029	396
East Germany	6 928	342
West Germany	6 774	334
Denmark	6 015	297
France	5 798	286
Belgium	5 791	286
Austria	5 688	280
U.S.S.R.	5 582	275
Japan	5 533	273
United Kingdom	5 366	265
Netherlands	4 774	235
Italy	3 681	182
Spain	3 262	161
South Africa	3 195	158
Argentina	1 578	78
Brazil	1 532	76
Mexico	1 188	59
Egypt	523	26
China	423	21
India	262	13
Nigeria	99	5
World Average **	2 028	100

* The first ten countries are listed according to their actual global rankings. The remaining countries are given in descending order of consumption; however, since only the most populous countries from each region were selected, the list does not indicate their true global rankings.

** Average for all 188 countries or areas included in source reference.

Source: *Energy Statistics Yearbook, 1986, United Nations, pp.406-419.*

Table 2.4. International comparison of total electricity consumption growth rates

Country	1984	1985	1986	Average 1984-86
	(per cent)			
Jordan	18.1	9.2	10.1	12.5
Indonesia	9.0	21.2	3.7	11.3
Turkey	12.6	6.5	14.2	11.1
India	12.0	8.6	10.3	10.3
Kuwait	10.7	10.5	9.7	10.3
South Korea	10.0	7.5	11.2	9.6
Pakistan	11.0	5.2	12.0	9.4
Thailand	11.1	9.5	7.2	9.3
Brazil	9.9	7.8	8.5	8.7
China	7.4	9.0	8.2	8.2
Malaysia	8.1	9.6	7.0	8.2
Singapore	8.5	5.3	7.6	7.1
Australia	6.3	7.7	4.9	6.3
France	5.4	7.1	5.1	5.9
Sweden	8.7	9.2	-1.2	5.6
Canada	6.4	5.0	3.8	5.1
Argentina	4.5	0.8	8.3	4.5
U.S.S.R	5.2	3.3	3.6	4.0
Spain	5.1	3.4	1.6	3.4
Italy	4.8	2.7	2.5	3.3
Egypt	3.4	5.7	0.7	3.3
New Zealand	3.9	3.1	3.0	3.3
United Kingdom	1.8	4.8	3.0	3.2
United States	4.8	3.5	0.5	2.9
Japan	4.9	3.6	0.0	2.8
West Germany	3.8	3.1	0.6	2.5
World Total*	5.5	4.3	2.7	4.2

* Total for all 188 countries or areas included in source reference.

Source: Calculated from *Energy Statistics Yearbook, 1986, United Nations, pp.406-419.*

Table 2.5. International comparison of electricity exports, 1986*

Country	Exports** (GW.h)	Production (GW.h)	Percentage of Exports to Production
Canada	38 934	468 571	8.3
France	33 000	343 045	9.6
U.S.S.R.	29 000	1 598 890	1.8
Switzerland	23 098	54 857	42.1
West Germany	15 461	406 386	3.8
Czechoslovakia	8 620	84 775	10.2
Poland	7 796	140 294	5.6
Austria	7 426	44 134	16.8
Sweden	6 451	138 023	4.0
Belgium	5 521	57 621	9.6
United States	4 816	2 582 510	0.2
Spain	4 152	127 713	3.3
East Germany	3 873	115 291	3.4
Uruguay	3 151	7 429	42.4
Zambia	3 100	10 100	30.7
Yugoslavia	2 178	77 381	2.8
Norway	2 169	96 359	2.3
Denmark	2 083	30 720	6.8
Italy	1 814	188 989	1.0
Bulgaria	1 470	41 817	3.5
Mexico	1 468	97 518	1.5
Hungary	1 346	28 063	4.8
Hong Kong	1 208	21 412	5.6
Portugal	989	20 225	4.9
Laos	756	1 050	72.0
Total World Exports ***	214 052	9 962 264	2.2

* Includes the world's 25 largest electricity exporters.

** Includes non-cash exchanges.

*** Total for all exporting countries or areas listed in source reference.

Source: *Energy Statistics Yearbook, 1986, United Nations, pp.406-419.*

Table 2.6. International comparison of electricity imports, 1986*

Country	Imports** (GW.h)	Consumption (GW.h)	Percentage of Imports to Consumption
United States	40 713	2 582 510	1.6
Italy	23 928	211 103	11.3
West Germany	20 592	411 517	5.0
Switzerland	14 512	46 271	31.4
Hungary	11 862	38 579	30.8
Brazil	10 568	212 177	5.0
Czechoslovakia	10 077	86 232	11.7
Poland	7 833	140 331	5.6
France	7 800	317 845	2.5
Finland	6 212	52 575	11.8
Austria	5 962	44 134	13.5
Bulgaria	5 427	45 774	11.9
Belgium	5 308	57 621	9.2
Canada	4 957	434 594	1.1
East Germany	4 872	116 290	4.2
Norway	4 212	98 402	4.3
Luxembourg	3 915	4 053	96.6
Romania	3 000	74 580	4.0
Zimbabwe	3 000	5 988	50.1
Portugal	2 874	22 110	13.0
Spain	2 896	126 457	2.3
Yugoslavia	2 664	77 867	3.4
Netherlands	2 383	69 494	3.4
Denmark	2 165	30 802	13.0
Sweden	1 819	133 391	1.4
Total World Imports***	220 913	9 969 125	2.2

* Includes the world's 25 largest electricity importers.

** Includes non-cash exchanges.

*** Total for all importing countries or areas listed in source reference.

Source: *Energy Statistics Yearbook, 1986, United Nations, pp.406-419.*

Table 2.7. International comparison of electricity intensity*

Country**	1960	1965	1970	1975	1980	1985	1986
(kW.h/U.S. \$1980)							
Canada	1.07	1.07	1.20	1.23	1.29	1.42	1.39
Norway	1.30	1.55	1.56	1.58	1.45	1.59	1.38
Iceland	0.48	0.44	0.84	0.97	0.98	1.07	1.09
New Zealand	0.51	0.63	0.73	0.87	0.98	1.03	1.06
Sweden	0.52	0.58	0.63	0.70	0.78	1.02	0.97
Finland	0.40	0.53	0.60	0.66	0.77	0.91	0.86
United States	0.60	0.65	0.80	0.88	0.89	0.87	0.82
Portugal	0.39	0.44	0.48	0.57	0.68	0.83	0.81
Luxembourg	0.64	1.06	0.78	0.97	0.87	0.80	0.74
Australia	0.37	0.46	0.51	0.58	0.66	0.74	0.73
Greece	0.19	0.25	0.39	0.50	0.58	0.69	0.68
Ireland	0.28	0.38	0.49	0.50	0.57	0.57	0.57
Spain	0.26	0.29	0.37	0.42	0.51	0.56	0.54
Japan	0.45	0.47	0.53	0.57	0.55	0.53	0.51
Austria	0.42	0.44	0.46	0.47	0.49	0.52	0.51
United Kingdom	0.41	0.50	0.56	0.55	0.53	0.52	0.50
Turkey	0.15	0.20	0.26	0.32	0.43	0.48	0.48
West Germany	0.31	0.35	0.40	0.45	0.46	0.49	0.47
Belgium	0.29	0.32	0.36	0.40	0.43	0.47	0.46
France	0.27	0.29	0.32	0.34	0.40	0.44	0.44
Italy	0.34	0.39	0.42	0.46	0.48	0.51	0.41
Switzerland	0.31	0.31	0.32	0.37	0.38	0.42	0.41
Denmark	0.15	0.21	0.30	0.33	0.39	0.41	0.40
Netherlands	0.21	0.26	0.32	0.36	0.38	0.39	0.38

* Electricity intensity is defined as total electricity consumption per dollar of Gross Domestic Product.

** Due to limited availability of data, table includes only OECD-member countries.

Source: Real Gross Domestic Product in U.S. dollars was obtained from *National Accounts, 1960-1987*, Department of Economics and Statistics, OECD, February 1989. Electrical energy data were obtained from *Energy Statistics Yearbook*, United Nations, various issues.

Table 2.8. International comparison of electricity prices in the residential sector, 1988*

City	Country	Residential prices (U.S. cents/kW.h)
Cairo	Egypt	1.90
Winnipeg	Canada	3.85
Ottawa	Canada	4.05
Montreal	Canada	4.08
Calgary	Canada	4.15
Edmonton	Canada	4.28
Vancouver	Canada	4.54
Toronto	Canada	4.81
Regina	Canada	5.07
Fredericton	Canada	5.50
St. John's	Canada	5.74
Halifax	Canada	5.91
Stockholm	Sweden	6.28
Sydney	Australia	7.23
Charlottetown	Canada	7.49
Los Angeles	U.S.A.	7.64
Houston	U.S.A.	7.72
Kansas	U.S.A.	7.82
Chicago	U.S.A.	8.05
Rotterdam	Netherlands	10.24
Sao Paulo	Brazil	10.28
Geneva	Switzerland	10.70
New York	U.S.A.	10.96
Madrid	Spain	11.49
Brussels	Belgium	11.80
Dusseldorf	West Germany	12.64
Rome	Italy	16.42
Tokyo	Japan	22.33

* Based on typical monthly consumption of 750 kW.h.

Source: Canadian data were obtained from the Electrical Energy Branch, Energy, Mines and Resources Canada. U.S. data were obtained from *Typical Electric Bills*, Energy Information Administration, Department of Energy, January 1988. Data for other countries were obtained from a survey undertaken by the Electrical Energy Branch, Energy, Mines and Resources Canada, in January 1989.

Table 2.9. International comparison of electricity prices in the commercial sector, 1988*

City	Country	Commercial prices (U.S. cents/kW.h)
Winnipeg	Canada	3.97
Ottawa	Canada	4.13
Vancouver	Canada	4.44
Calgary	Canada	4.58
Edmonton	Canada	5.01
Montreal	Canada	5.29
Toronto	Canada	5.67
Houston	U.S.A.	6.15
Fredericton	Canada	6.24
Stockholm	Sweden	6.28
Cairo	Egypt	6.40
Regina	Canada	6.73
Charlottetown	Canada	6.80
St. John's	Canada	6.94
Halifax	Canada	7.04
Kansas	U.S.A.	7.45
Los Angeles	U.S.A.	7.51
Chicago	U.S.A.	7.81
Geneva	Switzerland	7.83
Sao Paulo	Brazil	8.00
Brussels	Belgium	10.50
Rome	Italy	10.97
Madrid	Spain	11.23
Rotterdam	Netherlands	11.36
New York	U.S.A.	11.58
Sydney	Australia	11.82
Tokyo	Japan	18.16
Dusseldorf	West Germany	18.87

* Based on a typical monthly billing demand of 100 kW and energy consumption of 25 000 kW.h.

Source: Canadian data were obtained from the Electrical Energy Branch, Energy, Mines and Resources Canada. U.S. data were obtained from *Typical Electric Bills*, Energy Information Administration, Department of Energy, January 1988. Data for other countries were obtained from a survey undertaken by the Electrical Energy Branch, Energy, Mines and Resources Canada, in January 1989.

Table 2.10. International comparison of electricity prices in the industrial sector, 1988*

City	Country	Industrial prices (U.S. cents/kW.h)
Cairo	Egypt	1.20
Winnipeg	Canada	2.81
Calgary	Canada	3.30
Vancouver	Canada	3.35
Montreal	Canada	3.60
Ottawa	Canada	3.70
Fredericton	Canada	3.98
Edmonton	Canada	4.02
Toronto	Canada	4.30
Halifax	Canada	4.54
Houston	U.S.A.	5.15
St. John's	Canada	5.18
Stockholm	Sweden	5.27
Regina	Canada	5.35
Kansas	U.S.A.	5.77
Sydney	Australia	5.85
Charlottetown	Canada	5.93
Geneva	Switzerland	5.97
Chicago	U.S.A.	6.01
Los Angeles	U.S.A.	6.68
Sao Paulo	Brazil	6.82
Rome	Italy	7.44
Brussels	Belgium	7.90
Madrid	Spain	8.62
New York	U.S.A.	9.60
Rotterdam	Netherlands	10.24
Dusseldorf	West Germany	10.82
Tokyo	Japan	11.80

* Based on a typical monthly billing demand of 1 000 kW and energy consumption of 400 000 kW.h.

Source: Canadian data were obtained from the Electrical Energy Branch, Energy, Mines and Resources Canada. U.S. data were obtained from *Typical Electric Bills*, Energy Information Administration, Department of Energy, January 1988. Data for other countries were obtained from a survey undertaken by the Electrical Energy Branch, Energy, Mines and Resources Canada, in January 1989.

3. ELECTRICITY CONSUMPTION

Electricity consumption is affected by many factors: economic activity, demographic variables, electricity prices, other energy prices, conservation, technological changes, and weather. However, aggregate economic activity (as measured by the Gross Domestic Product) is the most important variable.

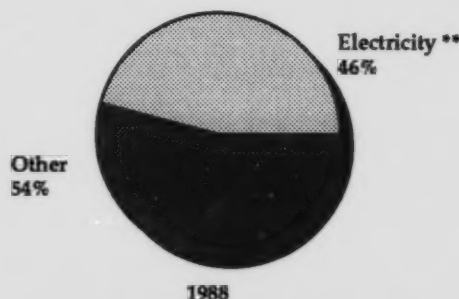
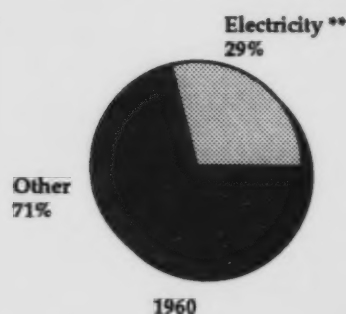
Between 1960 and 1988, real Gross Domestic Product grew at 4.4 per cent annually, compared with 5.3 per cent for electricity consumption (tables 3.1 and 3.2). During the same period, the average annual growth rate of petroleum demand was 2.4 per cent, coal 3.6 per cent, and natural gas 7.2 per cent.

Peak demand grew at a slightly faster rate than that of energy demand. From 1960 to 1988, the average annual growth rate for peak demand in Canada was 5.5 per cent, compared with energy demand at 5.3 per cent (Table 3.5). This implies that the load factor for the Canadian electric system has declined since 1960 (Table 3.6).

Figure 3.1. Primary energy consumption in Canada*

Total consumption: 4 045 petajoules

Total consumption: 10 919 petajoules



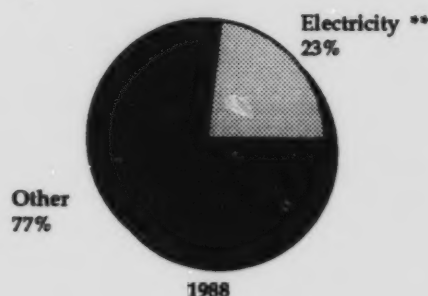
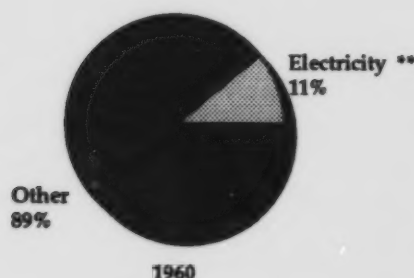
* Primary energy is the amount of energy available to the final consumer, plus conversion losses and energy used by the energy supply industries themselves.

** Converted at 10.5 megajoules per kilowatt hour.

Figure 3.2. Secondary energy consumption in Canada*

Total consumption: 2 941 petajoules

Total consumption 6 369 petajoules



* Secondary energy is the amount of energy available to, and used by, the consumer in its final form.

** Converted at 3.5 megajoules per kilowatt hour.

Table 3.1. Electricity consumption by province

	Electricity consumption (GW.h)								Average annual growth rate (per cent)			
	1960	1965	1970	1975	1980	1985	1987	1988*	1960-74	1975-88	1960-88	1987-88
Nfld.	1 427	2 684	4 770	6 206	8 545	9 658	9 697	10 423	11.5	4.1	7.4	7.5
P.E.I.	79	137	250	421	518	578	647	704	11.9	4.0	8.1	8.8
N.S.	1 733	2 502	3 706	5 697	6 814	7 626	8 326	8 912	8.7	3.5	6.0	7.0
N.B.	1 684	2 905	4 221	6 713	8 838	10 514	12 376	12 646	10.1	5.0	7.5	2.2
Que.	44 002	52 229	69 730	89 932	118 254	144 761	158 196	163 328	5.4	4.7	4.8	3.2
Ont.	37 157	49 276	69 488	89 197	106 509	122 460	132 174	140 677	6.4	3.6	4.9	6.4
Man.	4 021	5 942	8 601	11 890	13 927	15 912	15 862	16 867	7.9	2.7	5.3	6.3
Sask.	2 124	3 449	5 402	7 187	9 827	12 050	12 452	13 455	9.2	4.9	6.8	8.1
Alta.	3 472	5 603	9 880	15 246	23 172	33 295	36 589	39 325	10.7	7.6	9.1	7.5
B.C.	13 413	19 170	25 761	32 689	42 789	49 150	50 934	54 078	6.9	4.0	5.1	6.2
Yukon	89	109	220	352	381	252	432	439	9.3	1.7	5.9	1.6
N.W.T.	100	159	308	425	494	594	467	466	10.2	0.7	5.7	-0.2
Canada	109 304	144 165	202 337	265 955	340 068	406 859	438 152	461 320	6.6	4.3	5.3	5.3

* Preliminary data.

Source: *Electric Power Statistics, Volume II, Statistics Canada, catalogue 57-202.*

Table 3.2. Electricity consumption in Canada by sector

	Electricity consumption (GW.h)								Average annual growth rate (per cent)			
	1960	1965	1970	1975	1980	1985	1987	1988*	1960-74	1975-88	1960-88	1987-88
Residential	20 397 (19)	29 738 (20)	43 431 (21)	64 128 (24)	92 440 (27)	113 983 (28)	119 313 (27)	123 650 (27)	7.9	5.2	6.7	3.6
Commercial	12 632 (12)	23 859 (17)	44 068 (22)	65 744 (25)	75 912 (21)	85 320 (21)	98 888 (23)	100 741 (22)	12.4	3.3	7.7	1.9
Industrial	66 353 (60)	79 118 (55)	98 450 (49)	109 743 (41)	142 247 (42)	171 803 (42)	185 195 (42)	204 052 (44)	4.3	4.9	4.1	10.2
Line losses**	9 920 (9)	11 450 (8)	16 388 (8)	26 340 (10)	32 469 (10)	35 753 (9)	34 758 (8)	32 877 (8)	6.5	1.7	4.4	-5.4
Total	109 304 (100)	144 165 (100)	202 337 (100)	265 955 (100)	340 068 (100)	406 859 (100)	438 152 (100)	461 320 (100)	6.6	4.3	5.3	3.9

* Preliminary data.

** Losses during transmission and distribution.

Figures in parentheses are percentage shares.

Source: *Electric Power Statistics, Volume II, Statistics Canada, catalogue 57-202.*

Figure 3.3. Electricity generation, consumption and net transfers, 1988, (GW.h)

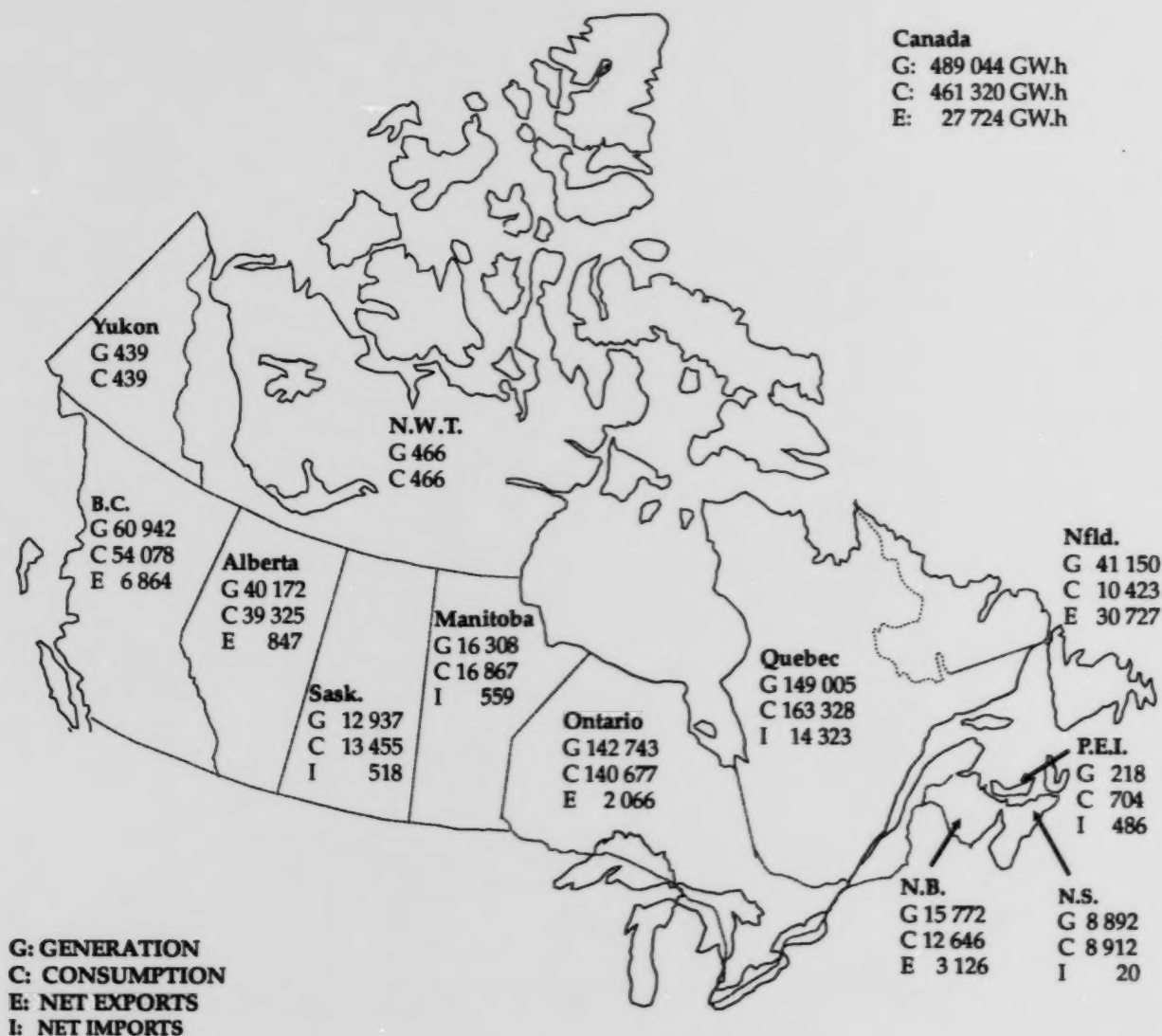


Table 3.3. Provincial electricity consumption and generation, 1988 (GW.h)

	Generation	Exports to		Imports from		Consumption
		Provinces	U.S.A.*	Provinces	U.S.A.*	
Nfld.	41 150	30 727	0	0	0	10 423
P.E.I.	218	0	0	486	0	704
N.S.	8 892	166	0	186	0	8 912
N.B.	15 772	981	5 191	2 856	190	12 646
Que.	149 005	4 979	11 863	31 079	86	163 328
Ont.	142 743	65	7 439	2 827	2 611	140 677
Man.	16 308	1 908	628	1 126	1 969	16 867
Sask.	12 937	1 109	57	1 369	315	13 455
Alta.	40 172	1 218	0	369	0	39 325
B.C.	60 942	364	8 851	1 219	1 132	54 078
Yukon	439	0	0	0	0	439
N.W.T.	466	0	0	0	0	466
Canada	489 044	41 517	34 029	41 517	6 305	461 320

* - Service exchange is included.

Source: Energy, Mines and Resources Canada.

Figure 3.4. Historical relationship between electricity demand and GDP, 1960-1988

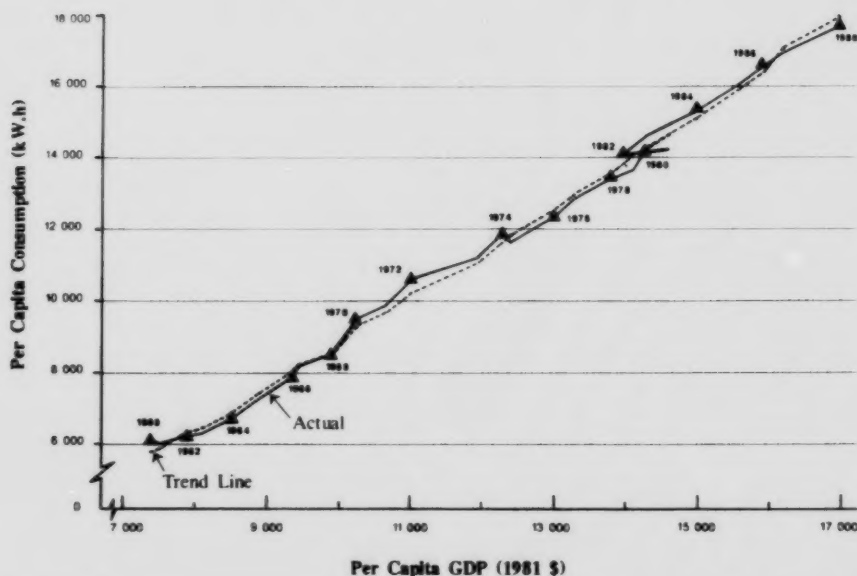


Table 3.4. Per capita electricity consumption by province

	Per capita consumption (kW.h/person)								Average annual growth rate (per cent)			
	1960	1965	1970	1975	1980	1985	1987	1988	1960-74	1975-88	1960-88	1987-88
Nfld.	3 184	5 500	9 226	11 304	14 758	16 632	16 745	18 347	10.1	3.8	6.5	9.6
P.E.I.	765	1 257	2 273	3 598	4 177	4 608	5 043	5 470	11.1	3.3	7.3	8.5
N.S.	2 385	3 310	4 739	6 948	7 988	8 668	9 370	10 083	7.9	2.9	5.3	7.6
N.B.	2 864	4 724	6 732	10 095	14 850	16 058	17 115	17 702	9.2	4.4	6.7	3.4
Que.	8 565	9 187	11 597	14 555	18 735	21 991	23 720	24 601	4.1	4.1	3.8	3.7
Ont.	6 086	7 259	9 203	10 915	12 422	13 510	14 205	14 917	4.3	2.4	3.3	5.0
Man.	4 932	6 158	8 750	11 726	13 521	14 863	14 649	15 550	6.3	2.2	4.2	6.2
Sask.	1 750	3 631	5 741	7 924	10 131	11 839	12 169	13 306	11.6	4.1	7.5	9.3
Alta.	2 695	3 864	6 194	8 575	11 135	14 120	15 277	16 378	8.4	5.1	6.7	7.2
B.C.	8 386	10 680	12 124	13 433	16 220	17 038	17 356	18 123	3.9	2.3	2.8	4.4
Yukon	4 589	7 569	11 957	16 526	17 085	10 862	18 633	17 352	8.7	0.4	4.9	-6.9
N.W.T.	5 304	5 540	8 851	10 316	11 052	11 647	9 174	8 996	3.5	-1.1	1.9	-1.9
Canada	6 184	7 339	9 501	11 718	13 112	16 043	17 121	17 796	4.9	3.3	3.8	3.9

Source: Electrical Energy Branch, Energy, Mines and Resources Canada.

Table 3.5. Peak demand by province*

	Peak demand (MW)								Average annual growth rate (per cent)			
	1960	1965	1970	1975	1980	1985	1987	1988**	1960-74	1975-88	1960-88	1987-88
Nfld.	245	422	763	1 031	1 538	1 510	1 674	1 740	12.5	4.1	7.3	3.9
P.E.I.	21	35	55	85	104	93	105	127	11.7	3.1	6.6	21.0
N.S.	356	457	814	998	1 197	1 360	1 543	1 706	8.6	4.2	5.8	10.6
N.B.	319	528	726	1 101	1 699	1 888	2 367	2 525	10.8	6.6	7.7	6.7
Que.	5 871	8 228	11 127	15 114	20 680	25 618	28 862	28 688	7.8	5.1	5.8	-0.6
Ont.	6 391	8 596	12 048	15 570	17 767	21 533	23 520	23 816	6.5	3.3	4.8	1.3
Man.	772	1 022	1 565	2 326	2 681	2 932	3 301	3 437	8.3	3.1	5.5	4.1
Sask.	418	653	1 028	1 318	2 085	2 202	2 201	2 280	9.7	4.3	6.3	3.6
Alta.	714	1 121	1 894	2 713	3 879	5 259	5 326	5 823	11.1	6.1	7.8	9.3
B.C.	2 123	3 058	4 492	5 797	7 384	8 487	8 759	8 054	8.2	2.6	4.9	-8.0
Yukon	19	16	39	66	75	53	68	75	9.4	1.0	5.0	10.3
N.W.T.	15	31	41	68	81	96	111	111	11.8	3.8	7.4	0.0
Canada	17 264	24 167	34 592	46 187	59 170	71 031	77 837	78 382	7.8	4.2	5.5	0.7

* Peak demand is the annual maximum average net kilowatt load of one-hour duration within an electrical system.

** Preliminary data.

Source: Electric Power Statistics, Volume I, Statistics Canada, catalogue 57-204.

Table 3.6. Load factor by province*

	1960	1965	1970	1975	1980	1985	1987	1988
	(per cent)							
Nfld.	66.5	72.6	71.4	68.7	65.3	64.5	66.1	68.4
P.E.I.	66.4	65.4	65.8	65.4	68.4	64.9	70.3	63.3
N.S.	59.5	66.4	62.7	58.4	59.3	62.0	61.6	59.6
N.B.	58.0	60.3	60.0	62.2	53.8	62.5	59.7	57.2
Que.	85.6	72.5	71.5	67.9	65.3	64.5	62.6	65.0
Ont.	66.4	65.4	65.8	65.4	68.4	64.9	64.2	67.4
Man.	59.5	66.4	62.7	58.4	59.3	62.0	54.9	56.0
Sask.	58.0	60.3	60.0	62.2	53.8	62.5	64.6	67.4
Alta.	55.5	57.1	59.6	64.2	68.2	72.3	78.4	77.1
B.C.	72.1	71.6	65.5	64.4	66.2	66.1	66.4	76.6
Yukon	53.5	77.8	64.4	60.9	58.0	54.3	72.5	66.8
N.W.T.	76.1	58.6	85.8	71.3	69.6	70.6	48.0	47.9
Canada	72.3	68.1	66.8	65.7	65.6	65.1	64.3	67.2

* Load factor is the energy demand in kilowatt-hours divided by the product of the number of hours in the period and multiplied by the peak demand in kilowatts. In a year-base average, demand equals annual energy consumption divided by 8760 hours per year.

Source: Calculated from *Electric Power in Canada, 1988*, Tables 3.1 and 3.5.

4. ELECTRICITY GENERATION

Canada's electric power industry began in the 1880s with electricity generated by steam. In the early years, electricity was used mainly for home and street lighting. In the late-1880s and 1890s, the invention of the electric motor dramatically changed the industry from one that mainly provided nighttime power for lighting to one that also provided power for transportation and industry needs 24 hours a day. Following this, hydroelectric development spread rapidly, due to Canada's abundance of water resources. In 1920, hydro accounted for about 99 per cent of total electricity production in Canada. This percentage declined to 95 per cent by 1950 and 93 per cent by the end of 1960. By 1988, hydro production had further declined to 62 per cent (Table 4.1).

Although thermal generation, mainly from coal-fired stations, has been a part of Canada's generation mix since the

beginning of the electric power industry, for many years its share of total production did not increase significantly because of its relatively high cost of production. However, by the 1960s and 1970s, when most of Canada's economical hydro sites had been developed, the situation changed, and thermal generation became competitive.

After 1975, nuclear production emerged as an important source of electricity generation in Canada. Canadian nuclear power began in 1962 when the 25-MW Rolphon station went into operation in Ontario. In 1965, nuclear generation totalled only 88 GW.h, accounting for less than 0.1 per cent of total generated electricity in Canada. By 1980, the nuclear-production share increased to about 10 per cent of Canada's total, and by 1988 the percentage increased to 16 per cent.

To date, tidal power has played an insignificant role in electricity generation in Canada. However, it is worth noting that the 20-MW Annapolis tidal power plant in Nova Scotia, which began operation in 1984, is the first of its kind in North America.

Because of the rapid expansion of coal-fired stations in the 1960s and 1970s, coal consumption increased more than 28 times between 1960 and 1988 (Table 4.4). Most of the coal used for electricity generation is produced in Canada, with the exception of Ontario, where a large proportion is imported from the United States.

Oil is mainly used for peak-load generation, except in the Atlantic provinces and the Yukon and Northwest territories. Natural gas is used by industry for co-generation and by electric utilities for peak-load generation.

Table 4.1. Sources of electricity generation

Fuel Type	Electricity Generation								Average Annual Growth Rate			
	1960	1965	1970	1975	1980	1985	1987	1988	1960-1974	1975-1988	1960-1988	1987-1988
	(GW.h)								(per cent)			
Hydro	105 883	117 063	156 709	202 396	251 217	301 250	313 156	303 524	5.1	3.2	3.8	-3.1
Thermal	8 495	27 123	47 045	59 138	80 207	88 842	96 031	107 322	14.3	4.7	9.5	11.8
Nuclear*	—	88	969	11 858	35 882	57 067	72 888	78 176	—	15.6	—	7.3
Tidal**	—	—	—	—	—	23	33	22	—	—	—	-16.7
Total	114 378	144 274	204 723	273 392	367 306	447 182	482 108	489 044	6.6	4.6	5.3	1.4

* Commercial operation started in 1968.

** Commercial operation started in 1984.

Source: *Electric Power Statistics, Volume II, Statistics Canada, Catalogue 57-202.*

Figure 4.1. Major generating stations by province, 1988

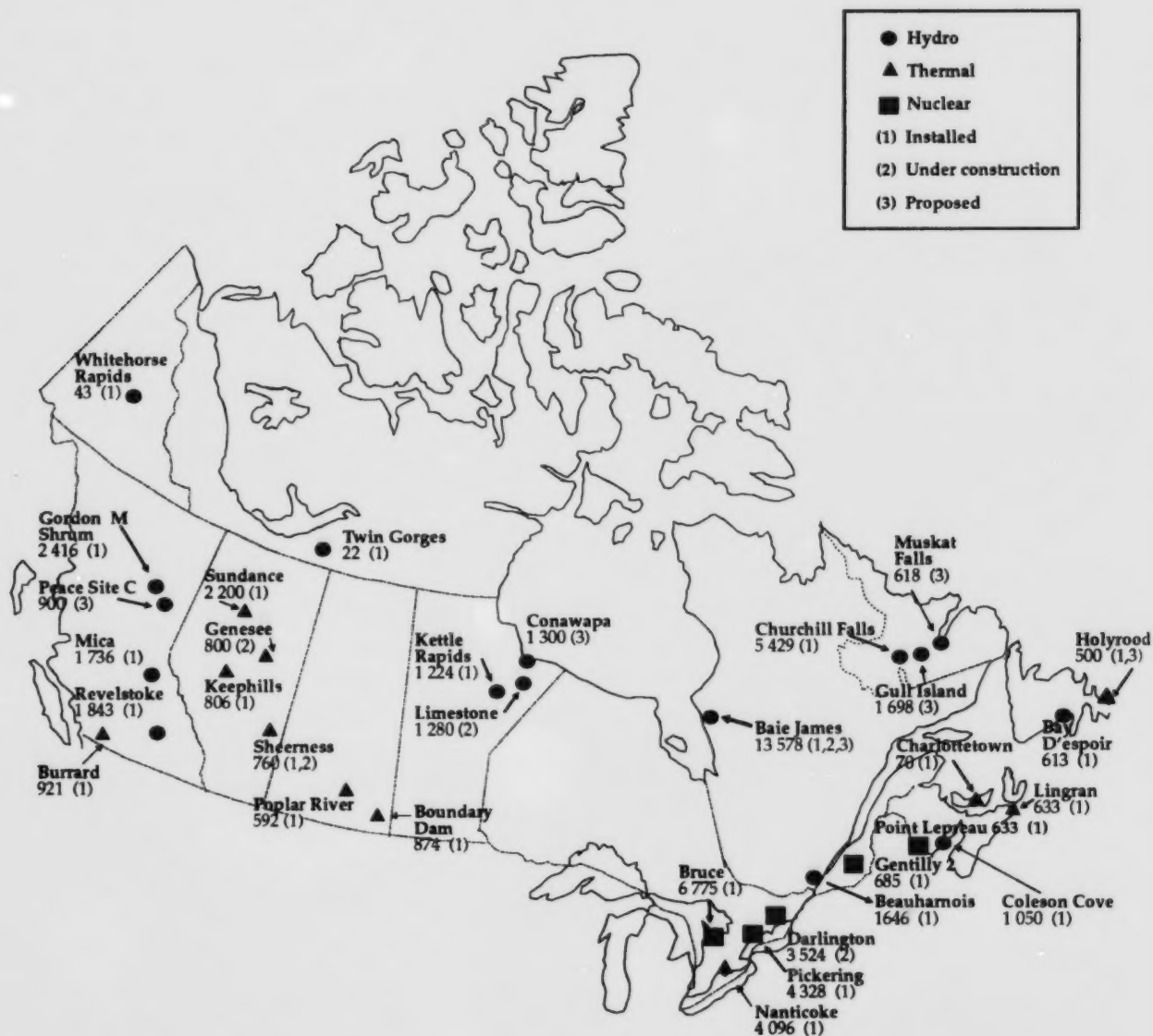


Figure 4.2. Electricity generation by fuel type

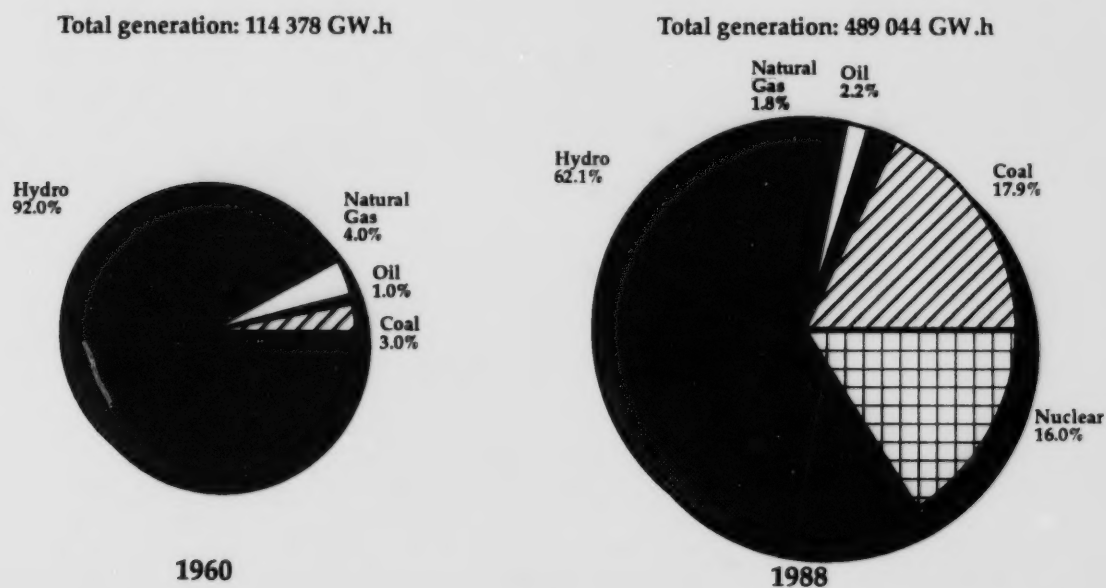


Table 4.2. Electrical energy production by fuel type, 1988

	Coal	Oil	Natural Gas	Nuclear	Hydro	Total
(GW.h)						
Newfoundland	0	1 419	0	0	39 731	41 150
Prince Edward Island	133	85	0	0	0	218
Nova Scotia	6 033	1 752	0	0	1 107	8 892
New Brunswick	1 732	6 118	0	5 342	2 580	15 772
Quebec	0	332	0	5 282	143 391	149 005
Ontario	35 033	510	1 334	67 552	38 314	142 743
Manitoba	924	0	5	0	15 379	16 308
Saskatchewan	9 853	19	722	0	2 343	12 937
Alberta	33 627	120	4 994	0	1 431	40 172
British Columbia	0	420	1 949	0	58 573	60 942
Yukon	0	30	0	0	409	439
Northwest Territories	0	177	1	0	288	466
Canada	87 335	10 982	9 005	78 176	303 546	489 044

Source: Energy, Mines and Resources Canada.

Figure 4.3. Electricity generation by region

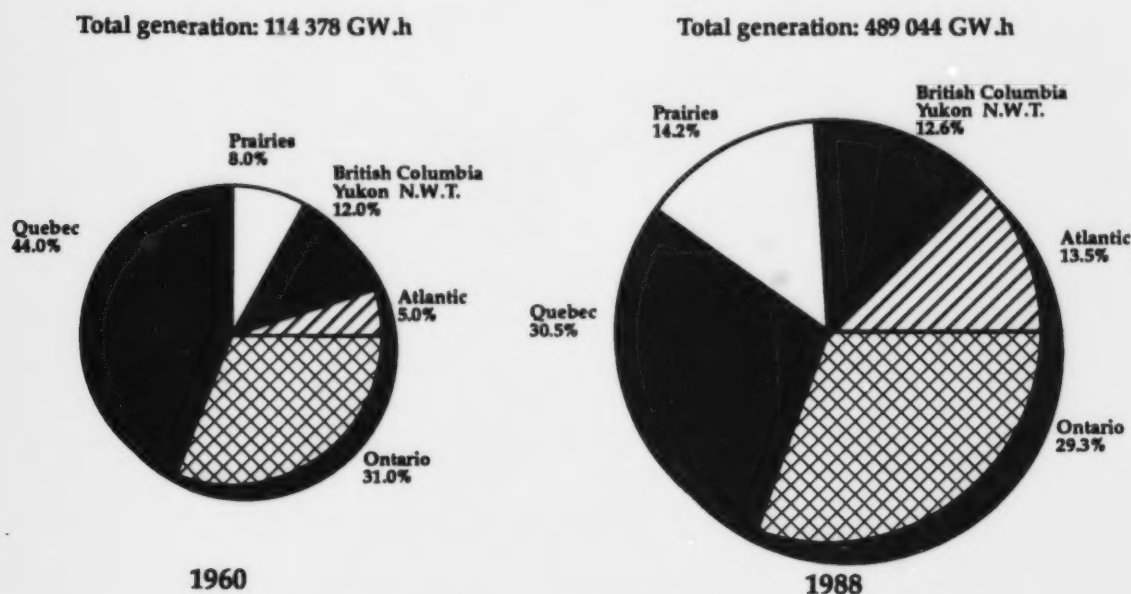


Table 4.3. Electricity generation by province

	Electricity Generation								Average Annual Growth Rate			
	1960	1965	1970	1975	1980	1985	1987	1988	1960-1974	1975-1988	1960-1988	1987-1988
	(GW.h)								(per cent)			
Nfld.	1 512	2 769	4 854	35 803	46 374	41 494	40 090	41 150	23.4	1.1	12.5	2.6
P.E.I.	79	137	250	421	127	2	164	218	11.9	-4.9	3.7	32.9
N.S.	1 814	2 632	3 511	5 498	6 868	7 457	7 749	8 892	8.2	3.8	5.8	14.8
N.B.	1 738	2 960	5 142	4 677	9 323	11 401	12 493	15 772	8.7	9.8	8.2	26.2
Quebec	50 433	57 005	75 877	76 108	97 917	137 028	156 952	149 005	3.7	5.3	3.9	-5.1
Ontario	35 815	44 858	63 857	78 558	110 283	121 783	131 582	142 743	6.2	4.7	5.1	8.5
Manitoba	3 742	5 489	8 449	14 818	19 468	22 777	19 902	16 308	10.2	0.7	5.4	-18.1
Sask.	2 204	3 733	6 011	7 090	9 204	11 838	12 440	12 937	9.0	4.7	6.5	4.0
Alberta	3 443	5 591	10 035	15 100	23 451	33 432	36 770	40 172	10.8	7.8	9.2	9.3
B.C.	13 409	18 832	26 209	34 542	43 416	59 124	63 067	60 942	7.4	4.5	5.6	-3.4
Yukon	89	121	224	352	381	252	432	439	9.3	1.7	5.9	1.6
N.W.T.	100	147	304	425	494	594	467	466	10.2	0.7	5.7	-0.2
Canada	114 378	144 274	204 723	273 392	367 306	447 182	482 108	489 044	6.6	4.6	5.3	1.4

Source: *Electric Power Statistics, Volume II, Statistics Canada, Catalogue 57-202.*

Table 4.4. Fuels used to generate electricity in Canada

	1960	1965	1970	1975	1980	1985	1987	1988*
Coal (10 ³ tonnes)	1 674	7 004	13 786	16 567	27 785	39 456	43 332	47 443
Oil (10 ³ cubic metres)	328	871	1 869	2 309	2 867	1 391	2 048	2 454
Natural gas (10 ⁶ cubic metres)	1 069	1 679	1 992	4 009	1 875	1 223	2 847	3 628
Uranium (tonnes)	0	2	16	194	685	1 086	1 303	1 358

* Preliminary data.

Source: *Electric Power Statistics, Volume II, Statistics Canada, Catalogue 57-202.***Table 4.5. Fossil fuels used by utilities, 1988**

	Coal (10 ³ tonnes)	Oil (cubic metres)	Gas (10 ⁶ cubic metres)	Uranium (tonnes)
Nfld.	0	368 006	0	0
P.E.I.	51	37 700	0	0
N.S.	2 266	393 051	0	0
N.B.	663	1 369 114	0	98
Que.	0	55 905	0	99
Ont.	14 473	156 432	1 141	1 161
Man.	768	548	9	0
Sask.	8 637	4 801	265	0
Alta.	20 585	30	2 077	0
B.C.	0	85	122	0
Yukon	0	8 410	0	0
N.W.T.	0	60 005	14	0
Canada	47 443	2 454 087	3 628	1 358

Note: 1 cubic metre oil = 6.3 barrels
 1 cubic metre gas = 35.5 cubic feet
 1 tonne = 1000 kilograms

Source: *Energy, Mines and Resources Canada.*

5. GENERATING CAPACITY AND RESERVE

Although Canada's first electrical generating stations were thermal, by 1920 hydro accounted for 86 per cent of total generating capacity. With growing demand, hydroelectric power quickly proved to be more economical than thermal, and by 1945 hydro's share of total installed capacity peaked at 94 per cent. Its capacity share then declined to about 81 per cent by 1960, and declined further to 56 per cent by 1988 (Table 5.1).

Several factors have contributed to the gradual reduction of the hydro capacity share since 1960. By that date most of Canada's economic hydro sites had been developed. Moreover, the growth rates of real fossil-fuel prices (coal, oil and natural gas) were negative between 1950 and 1974, thus leading many utilities to construct thermal stations during this period.

In addition, in the early 1960s, Canada began to develop nuclear energy as an alternative source for future energy demand. By 1988, Canada owned and operated 18 large CANDU reactors (500 MW and up). CANDU's have been shown to be among the best nuclear reactors in the world in terms of cost-effectiveness, safety measures, and output performance (Figure 5.3).

As indicated in Chapter 3, electricity consumption in Canada grew rapidly from 1960 to 1974, with an average annual increase of 6.6 per cent. In the early 1970s, the construction of new generating stations was initiated based on expectations of continuing rapid growth in electricity demand, and also to displace oil-fuelled electricity production. Following the oil crisis of 1973-74, however,

electricity demand slowed to an average of 4.3 per cent for the period 1975-88. This shift, from a long period of sustained rapid growth to one of slower growth, has resulted in excess generating capacity (Table 5.8).

There is still a large amount of undeveloped hydroelectric potential in Canada (Table 5.9 and Appendix C). Although much of this is unlikely to be developed due to the remoteness of the sites, the physical difficulty of the terrain, or because of environmental concerns, it is anticipated that a significant amount will be developed over the next 20 to 25 years. Quebec, British Columbia, Manitoba and Newfoundland have most of the remaining river potential. Tidal resources are located in Nova Scotia, Quebec and British Columbia.

Table 5.1. Installed generating capacity by fuel type, 1960-1988

Fuel Type	Installed Generating Capacity								Average Annual Growth Rate			
	1960	1965	1970	1975	1980	1985	1987	1988	1960-1974	1975-1988	1960-1988	1987-1988
	(MW)								(per cent)			
Hydro	18 643	21 771	28 298	37 282	47 770	57 711	57 925	57 464	5.0	3.4	4.1	-0.8
Thermal	4 392	7 557	14 287	21 404	28 363	30 476	30 800	30 914	11.7	2.9	7.2	0.4
Nuclear*	0	20	240	2 666	5 866	10 664	12 528	12 528	-	12.6	-	0.5
Tidal**	0	0	0	0	0	20	20	20	-	-	-	0.0
Total	23 035	29 348	42 826	61 352	81 999	97 020	100 273	100 984	6.8	3.9	5.4	-0.3

* Commercial operation started in 1968.

** Commercial operation started in 1984.

Source: *Electric Power Statistics, Volume II, Statistics Canada, Catalogue 57-202*

Figure 5.1. Installed generating capacity by fuel type

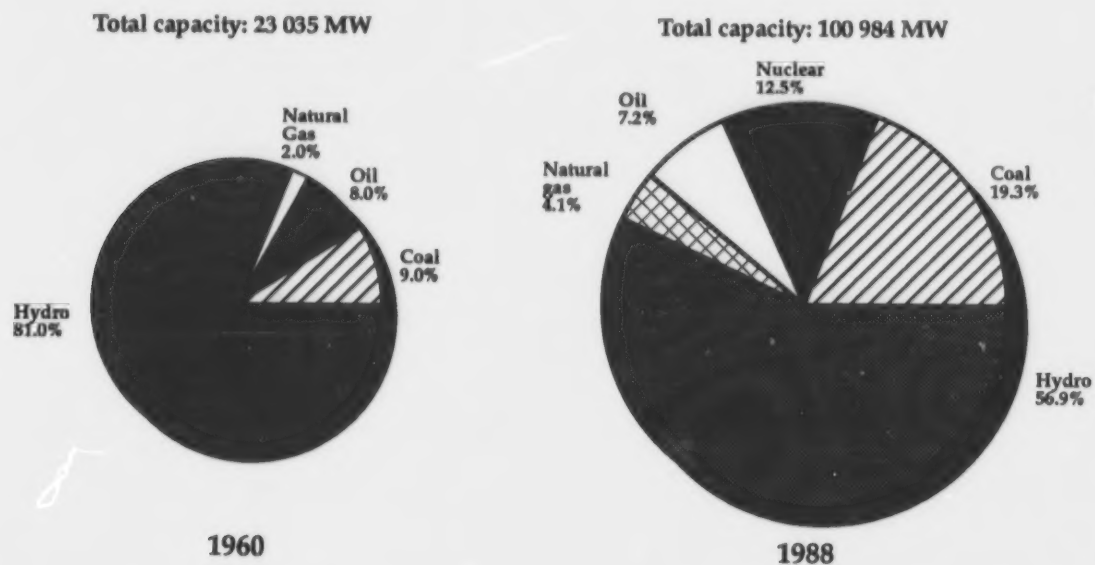


Figure 5.2. Installed generating capacity by region

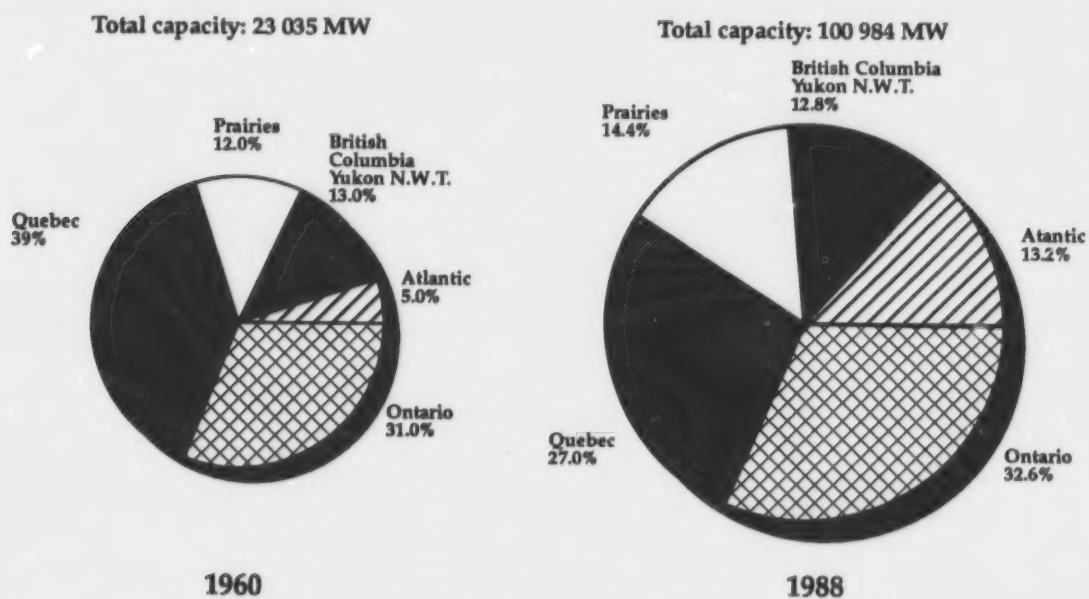


Table 5.2. Installed generating capacity by fuel type and province, 1988

	Hydro	Coal	Nuclear	Oil	Natural Gas	Total
	(MW)					
Nfld.	6 644	0	0	782	0	7 426
P.E.I.	0	20	0	122	0	142
N.S.	386	1 201	0	758	0	2 345
N.B.	903	356	680	1 532	0	3 471
Que.	25 585	0	685	980	8	27 258
Ont.	7 775	10 935	11 221	2 651	373	32 955
Man.	3 641	466	0	14	4	4 125
Sask.	832	1 554	0	27	432	2 845
Alta.	734	4 979	0	15	1 872	7 600
B.C.	10 848	0	0	246	1 403	12 497
Yukon	82	0	0	44	19	145
N.W.T.	54	0	0	121	20	175
Canada	57 484	19 511	12 586	7 292	4 111	100 984

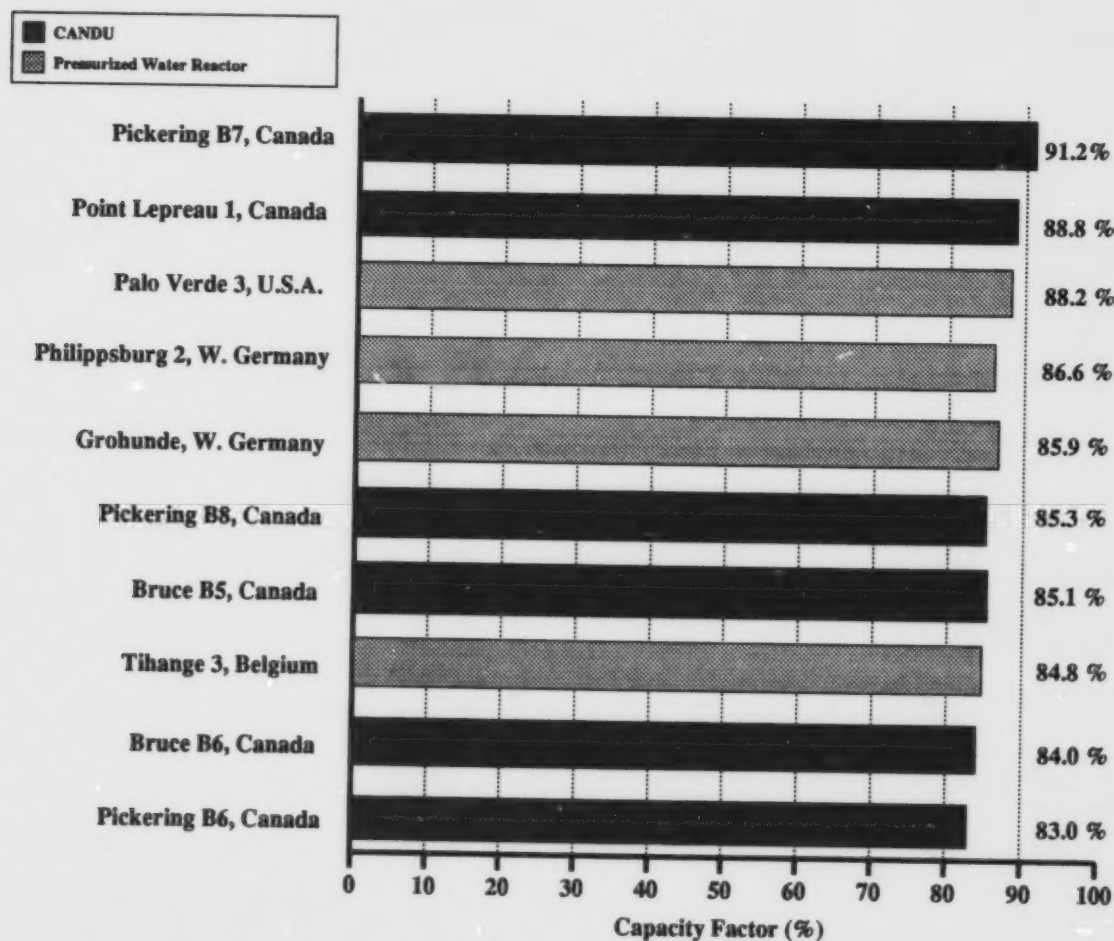
Source: *Electric Power Statistics, Volume II, Statistics Canada, Catalogue 57-204.*
Energy, Mines and Resources Canada.

Table 5.3. Installed generating capacity by province, 1960-1988

	Installed Generating Capacity								Average Annual Growth Rate			
	1960	1965	1970	1975	1980	1985	1987	1988	1960-1974	1975-1988	1960-1988	1987-1988
	(MW)								(per cent)			
Nfld.	314	531	1 248	6 668	7 195	7 316	7 401	7 426	21.4	0.8	12.0	0.3
P.E.I.	37	58	77	118	118	122	142	142	8.6	1.4	4.9	0.0
N.S.	507	631	931	1 263	2 029	2 373	2 345	2 345	6.4	4.9	5.6	0.0
N.B.	402	581	1 201	1 333	2 795	3 479	3 471	3 471	8.9	7.6	8.0	0.0
Quebec	8 920	10 769	14 047	15 037	20 531	26 991	27 827	27 258	3.7	4.7	4.1	-2.0
Ontario	7 109	9 292	13 700	21 136	25 796	29 932	32 703	32 955	7.0	3.5	5.6	0.8
Manitoba	1 043	1 407	1 794	2 970	4 142	4 141	4 125	4 125	7.8	2.6	5.0	0.0
Sask.	761	967	1 533	1 833	2 340	2 694	2 845	2 845	6.2	3.4	4.8	0.0
Alberta	915	1 398	2 674	3 585	5 807	7 219	7 600	7 600	9.9	6.0	7.9	0.0
B.C.	2 963	3 627	5 473	7 170	10 525	12 451	12 497	12 497	6.0	4.4	5.3	0.0
Yukon	31	56	58	102	94	123	142	145	5.6	2.7	5.7	2.1
N.W.T.	33	51	89	136	180	177	175	175	9.3	2.0	6.1	0.0
Canada	23 035	29 348	42 826	61 352	81 999	97 019	101 273	100 984	6.8	3.9	5.4	-0.3

Source: *Electric Power Statistics, Volume II, Statistics Canada, Catalogue 57-202.*

Figure 5.3. World nuclear reactor performance —lifetime* (to December 31, 1988)



* All nuclear reactors used in comparison are greater than 500 MW. COMECON countries are excluded. The lifetime performance is calculated from the first day of electricity generation.

Source: Uranium and Nuclear Energy Branch, Energy, Mines and Resources Canada.

Table 5.4. Canada's largest hydro stations, 1988

Rank	Name	Province	Rated Capacity (MW)	Year of Initial Operation
1	Churchill Falls	Newfoundland	5 429	1971
2	La Grande 2	Quebec	5 328	1979
3	La Grande 4	Quebec	2 651	1984
4	Gordon M. Shrum	B.C.	2 416	1968
5	La Grande 3	Quebec	2 302	1982
6	Revelstoke	B.C.	1 843	1984
7	Mica	B.C.	1 736	1976
8	Beauharnois	Quebec	1 639	1932
9	Manic 5	Quebec	1 292	1970
10	Sir Adam Beck 2	Ontario	1 288	1954

Source: *Electric Power Statistics, Volume III, Statistics Canada, Catalogue 57-206, 1987.*

Table 5.5. Canada's largest conventional thermal stations, 1988

Rank	Name	Fuel Type	Province	Rated Capacity (MW)	Year of Initial Operation
1	Nanticoke	coal	Ontario	4 096	1973
2	Lakeview	coal	Ontario	2 400	1962
3	Lennox	oil	Ontario	2 295	1976
4	Sundance	coal	Alberta	2 200	1970
5	Lambton	coal	Ontario	2 000	1969
6	Richard L. Hearn	coal	Ontario	1 200	1951
7	Coleson Cove	oil	N.B.	1 050	1976
8	Burrard	natural gas	B.C.	913	1962
9	Boundary Dam	coal	Saskatchewan	874	1959
10	Kepphills	coal	Alberta	806	1983

Source: *Electric Power Statistics, Volume III, Statistics Canada, Catalogue 57-206, 1987.*

Table 5.6. Commercial nuclear power plants in Canada, 1988

	Plant Name	Province	Rated Net Capacity (MW)	Commissioning Date
1	Pickering A1	Ontario	515	1971
2	Pickering A2	Ontario	515	1971
3	Pickering A3	Ontario	515	1972
4	Pickering A4	Ontario	515	1973
5	Bruce A1	Ontario	759	1977
6	Bruce A2	Ontario	769	1977
7	Bruce A3	Ontario	759	1978
8	Bruce A4	Ontario	769	1979
9	Point Lepreau 1	New Brunswick	635	1983
10	Pickering B5	Ontario	516	1983
11	Gentilly 2	Quebec	638	1983
12	Pickering B6	Ontario	516	1984
13	Bruce B6	Ontario	837	1984
14	Pickering B7	Ontario	516	1985
15	Bruce B5	Ontario	835	1985
16	Pickering B8	Ontario	516	1986
17	Bruce B7	Ontario	837	1986
18	Bruce B8	Ontario	837	1987

Source: Uranium and Nuclear Energy Branch, Energy, Mines and Resources Canada.

Table 5.7. Surplus capacity, 1988*

	Net Generating Capability for In-Province Use (MW) (1)	In-Province Firm peak (MW) (2)	Reserve Margin (MW) (3) = (1) - (2)	Percentage of Reserve (4) = (3) / (2)
Nfld.	2 072	1 917	1 055	55
P.E.I.	135	110	25	23
N.S.	2 019	1 574	445	22
N.B.	3 135	2 352	783	33
Que.	31 342	27 060	4 282	16
Ont.	28 750	23 672	5 078	22
Man.	4 335	3 345	990	30
Sask.	2 744	2 299	445	19
Alta.	7 387	5 611	1 776	32
B.C.	12 540	9 072	3 468	38
Yukon	122	69	53	77
N.W.T.	188	111	77	69
Canada	95 605	77 192	18 477	24

* Preliminary data.

Source: Electric Power Statistics, Volume I, Statistics Canada, Catalogue 57-204.

Table 5.8. Surplus capacity percentages, 1960-1988

	1960	1965	1970	1975	1980	1985	1987	1988
	(per cent)							
Nfld.	20	17	55	48	98	101	79	55
P.E.I.	81	66	33	33	13	40	33	23
N.S.	39	32	13	18	62	38	31	22
N.B.	17	9	49	34	33	51	15	33
Que.	37	16	16	10	14	20	21	16
Ont.	14	6	13	26	34	11	30	22
Man.	32	41	24	18	54	48	18	30
Sask.	60	28	26	30	7	15	22	19
Alta.	30	23	38	32	45	36	39	32
B.C.	43	19	23	30	49	50	43	38
Yukon	42	100	23	58	29	130	78	77
N.W.T.	87	48	42	46	51	70	68	69
Canada	28	15	19	25	31	26	21	24

Source: Calculated from *Electric Power Statistics, Volume I*, Statistics Canada, Catalogue 57-204.

Table 5.9. Hydroelectric capacity in Canada, 1988

Province or Territory	In-Operation and Under Construction	Remaining Potential		
		Gross*	Identified**	Planning***
		(MW)		
Newfoundland	6 675	5 201	4 623	2 395
Prince Edward Island	0	0	0	0
Nova Scotia	386	8 499	8 499	0
New Brunswick	903	940	600	440
Quebec	28 541	71 008	39 566	17 964
Ontario	7 775	12 385	12 305	4 024
Manitoba	4 921	8 190	5 090	5 090
Saskatchewan	830	2 189	935	870
Alberta	734	18 813	9 762	1 923
British Columbia	10 848	33 154	18 185	10 555
Yukon	82	18 583	13 701	350
Northwest Territories	50	9 229	9 201	2 473
Canada	61 745	188 191	122 467	46 084

* Gross Potential - The total gross resource that could be developed if there were no technical, economic or environmental constraints (excludes sites already developed or under construction).

** Identified Potential - Gross potential less sites that may not be developed for technical reasons.

*** Planning Potential - Identified potential less sites that may not be developed for environmental or economic reasons. The planning potential thus comprises all those sites that are considered to be likely candidates for future development.

Source: Canadian electrical utilities and Energy, Mines and Resources Canada.

6. ELECTRICITY TRADE

This chapter reports on electricity trade between Canada and the United States and on interprovincial electricity transfers.

Electricity exchanges between Canada and the United States date back to the beginning of the century. For most of the century, electricity trade between the two countries was balanced.

However, between the early 1970s and 1988, Canada's net exports grew substantially, largely due to the high cost of thermal production (particularly oil-fired generation) in the United States.

Preliminary data for 1988, however, indicate that electricity exports to the United States decreased by 27 per cent for revenue, and 29 per cent for volume over 1987 (Table 6.5). (The decrease is mainly attributed to drought conditions and higher domestic demand.) Although all major exporters experienced lower sales this year, the greatest reductions occurred in Quebec and British Columbia. Export reductions in these two provinces amounted to two-thirds of the total decrease in exports. Both provinces had significantly less hydraulic energy available for economy

energy sales than in previous years.

In 1988, the major export markets for Canadian electricity were New England and New York. The former accounted for about 34 per cent of Canada's total exports, and the latter 31 per cent.

In 1988, interprovincial exchanges totalled 41 517 GW.h, which accounted for about 8.5 per cent of Canada's total generation (Table 6.11).

Figure 6.1. Net electricity exports and Canadian merchandise trade balance, 1988

Total Merchandise Trade Balance
\$9.59 billion

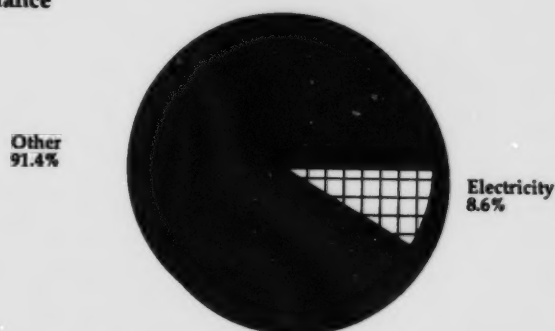


Figure 6.2 Net electricity exports and Canadian energy trade balance, 1988

Total Energy Trade Balance
\$7.61 billion

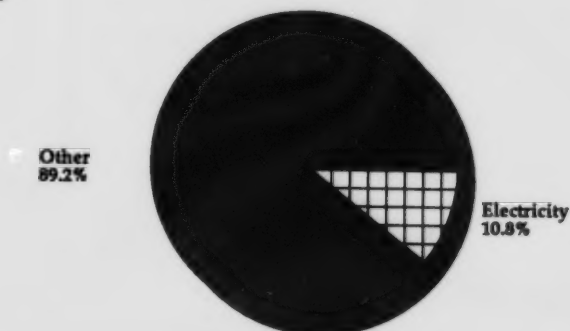


Table 6.1. Canada-U.S. electricity trade, 1960-1988

	Exports* (GW.h) (1)	Exports as a percentage of net generation (2)	Export revenues (\$million) (3)	Imports* (GW.h) (4)	Imports as a percentage of total disposal (5)	Import costs (\$million) (6)	Net Exports	
							GW.h (7) = (1) - (4)	\$Million (8) = (3) - (6)
1960	5 496	4.8	14	357	0.3	1	5 139	13
1961	4 158	3.7	10	1 394	1.3	2	2 764	8
1962	4 112	3.5	8	2 779	2.4	3	1 333	5
1963	3 613	3.0	7	2 884	2.4	3	729	4
1964	4 159	3.1	10	3 121	2.3	3	1 038	7
1965	3 684	2.6	8	3 575	2.5	3	109	5
1966	4 397	2.8	8	3 218	2.1	3	1 179	5
1967	3 994	2.4	8	4 181	2.6	6	-187	2
1968	3 988	2.1	8	4 129	2.3	6	-141	2
1969	4 320	2.3	15	2 740	1.5	3	1 580	12
1970	5 631	2.8	32	3 245	1.6	9	2 386	23
1971	7 321	3.4	45	3 378	1.6	8	3 943	37
1972	11 037	4.6	66	2 381	1.0	3	8 656	63
1973	16 286	6.2	115	2 249	0.9	1	14 037	114
1974	15 400	5.5	169	2 441	0.9	1	12 959	168
1975	11 409	4.2	105	3 972	1.5	3	7 819	102
1976	12 804	4.4	174	3 590	1.3	7	9 214	167
1977	19 957	6.3	419	2 690	0.9	13	17 267	406
1978	20 437	6.1	479	170	0.1	2	20 267	477
1979	30 458	8.6	739	24	0.0	1	30 434	738
1980	28 224	7.7	794	168	0.1	3	28 056	791
1981	34 730	9.1	1 144	466	0.1	5	34 264	1 138
1982	32 986	8.8	1 107	257	0.1	5	32 729	1 102
1983	37 258	9.4	1 249	239	0.1	6	37 019	1 243
1984	37 563	8.8	1 355	290	0.1	10	37 272	1 345
1985	41 441	9.3	1 425	231	0.1	9	41 210	1 416
1986	35 271	8.5	1 086	235	0.1	9	35 036	1 077
1987	45 359	9.4	1 211	536	0.1	12	44 823	1 199
1988	29 729	6.1	880	2 853	0.6	63	26 876	817

* Exports and imports prior to 1977 include service exchanges.

Source: *Electric Power Statistics, Volume II, Catalogue 57-202, Statistics Canada. Energy, Mines and Resources Canada.*

Table 6.2. Electricity exports to the United States by type, 1960-1988

	Quantity (GW.h)		Revenue (\$1000)		Quantity share (%)		Revenue share (%)	
	Firm	Interruptible	Firm	Interruptible	Firm	Interruptible	Firm	Interruptible
1960	1 040	4 456	4 328	10 023	19	81	30	70
1961	1 192	2 965	5 769	3 783	29	71	60	40
1962	1 261	2 851	6 487	1 775	31	69	79	21
1963	882	2 730	4 625	2 028	24	76	70	30
1964	871	3 289	5 561	4 359	21	79	56	44
1965	635	3 049	4 261	3 322	17	83	56	44
1966	614	3 783	4 257	3 402	14	86	56	44
1967	705	3 289	4 663	3 068	18	82	60	40
1968	741	3 247	5 003	2 714	19	81	65	35
1969	838	3 482	5 735	9 279	19	81	38	62
1970	984	4 648	6 828	25 309	18	82	21	79
1971	1 860	5 461	13 270	31 951	25	75	29	71
1972	2 047	8 990	19 198	46 846	19	81	29	71
1973	2 637	13 649	19 891	94 947	16	84	17	83
1974	2 488	12 912	20 939	147 945	16	84	12	88
1975	2 375	9 034	20 382	84 488	21	79	19	81
1976	2 061	10 743	39 010	134 755	16	84	22	78
1977	3 727	16 230	90 220	329 050	19	81	22	78
1978	3 980	16 457	94 543	384 011	20	80	20	80
1979	6 692	23 766	135 763	602 740	22	78	18	82
1980	7 232	20 992	156 731	636 760	26	74	20	80
1981	5 008	29 722	105 116	1 038 761	14	86	9	91
1982	5 831	27 154	243 140	863 558	18	82	22	78
1983	10 569	26 689	445 751	802 806	28	72	36	64
1984	10 852	26 711	491 662	863 057	29	71	36	64
1985	12 305	29 136	547 109	877 657	30	70	38	62
1986	9 745	25 526	480 233	605 254	28	72	44	56
1987	8 840	36 519	354 781	856 068	19	81	29	71
1988	8 331	21 398	327 132	553 406	28	72	37	63

Source: *Electric Power Statistics, Volume II, Catalogue 57-202, Statistics Canada. Energy, Mines and Resources Canada.*

Table 6.3. Average export revenues, 1960-1988

Year	Firm	Interruptible	Total
(mills/kW.h)			
1960	4.2	2.3	2.6
1961	4.8	1.3	2.3
1962	5.1	0.6	2.0
1963	5.2	0.7	1.8
1964	6.4	0.9	2.4
1965	6.7	1.1	2.1
1966	6.9	0.9	1.7
1967	6.6	0.9	1.9
1968	6.8	0.8	1.9
1969	6.8	2.7	3.5
1970	6.9	5.5	5.7
1971	7.1	5.9	6.2
1972	9.4	5.2	6.0
1973	7.5	7.0	7.1
1974	8.4	11.5	11.0
1975	8.6	9.4	9.2
1976	18.9	12.5	13.6
1977	24.2	20.3	21.0
1978	23.8	23.3	23.4
1979	20.3	25.4	24.3
1980	21.7	30.3	28.1
1981	21.0	34.9	32.9
1982	41.7	31.8	33.6
1983	42.2	30.1	33.5
1984	45.3	32.3	36.1
1985	44.5	30.1	34.4
1986	49.3	23.7	30.8
1987	40.1	23.4	26.7
1988	39.3	25.9	29.6

Source: Calculated from *Electric Power in Canada, 1988*, Table 6.2.

Table 6.4. Generation sources of Canadian exports, 1975-1988

	Hydro	Imported Coal	Imported Oil	Domestic Coal/Oil	Nuclear	Total
	(GW.h)					
1975	5 724	4 838	494	353	0	11 409
1976	6 973	4 323	1 206	302	0	12 804
1977	7 926	8 514	2 961	555	0	19 957
1978	7 290	10 476	2 260	411	0	20 437
1979	15 213	11 587	3 354	128	177	30 458
1980	14 135	10 599	2 867	593	30	28 224
1981	21 182	10 901	1 940	665	42	34 730
1982	20 114	10 315	1 959	502	96	32 986
1983	21 978	11 704	1 201	519	1 856	37 258
1984	22 807	10 582	1 552	711	1 911	37 563
1985	28 836	8 245	1 157	956	2 247	41 441
1986	25 727	5 389	846	825	2 484	35 271
1987	34 065	7 575	1 270	408	2 041	45 359
1988	19 621	4 531	1 393	2 033	2 151	29 729

Source: Compiled from National Energy Board statistics.

Table 6.5. Electricity exports and revenues by province, 1987-1988*

	Quantity (GW.h)			Revenue (million \$)			Average Revenue (mills/kW.h)		
	1987	1988	% Change	1987	1988	% Change	1987	1988	% Change
N.B.	5 910	5 052	-15	278.0	223.2	-20	47.1	44.2	-6
Que.	16 400	11 865	-28	445.4	345.6	-22	27.2	29.1	7
Ont.	7 194	5 623	-22	215.6	170.6	-21	30.0	30.3	1
Man.	3 314	723	-78	65.3	20.2	-69	19.7	27.9	42
Sask.	11	2	-82	0.2	0.03	-85	15.8	15.0	-5.1
B.C.	12 486	6 464	-48	206.4	120.8	-42	16.5	18.7	13
Canada	45 359	29 729	-35	1 210.9	880.5	-27	26.7	29.6	11

* Excludes non-cash exchanges.

Source: National Energy Board.

Table 6.6. Firm and interruptible exports, 1988*

	Firm	Interruptible	Firm	Interruptible
	(GW.h)		(per cent)	
New Brunswick	2 522	2 530	50	50
Quebec	4 921	6 944	41	59
Ontario	384	5 239	7	93
Manitoba	343	381	47	53
Saskatchewan	-	2	-	100
British Columbia	161	6 303	2	98
Canada	8 331	21 398	28	72

* Exchanges are excluded.

Source: National Energy Board.

Table 6.7. Energy sources of electricity exports, 1988

	Oil	Coal	Nuclear	Hydro	Other*	Total
	(per cent)					
New Brunswick	28	18	40	14	-	100
Quebec	-	-	-	100	-	100
Ontario	3	81	2	13	1	100
Manitoba	-	1	-	29	70	100
Saskatchewan	-	100	-	-	-	100
British Columbia	-	14	-	86	-	100
Canada	5	22	7	64	2	100

* Refers to U.S. electricity imports that are subsequently exported.

Source: Energy, Mines and Resources Canada.

Table 6.8. Exporting provinces and importing markets, 1988*

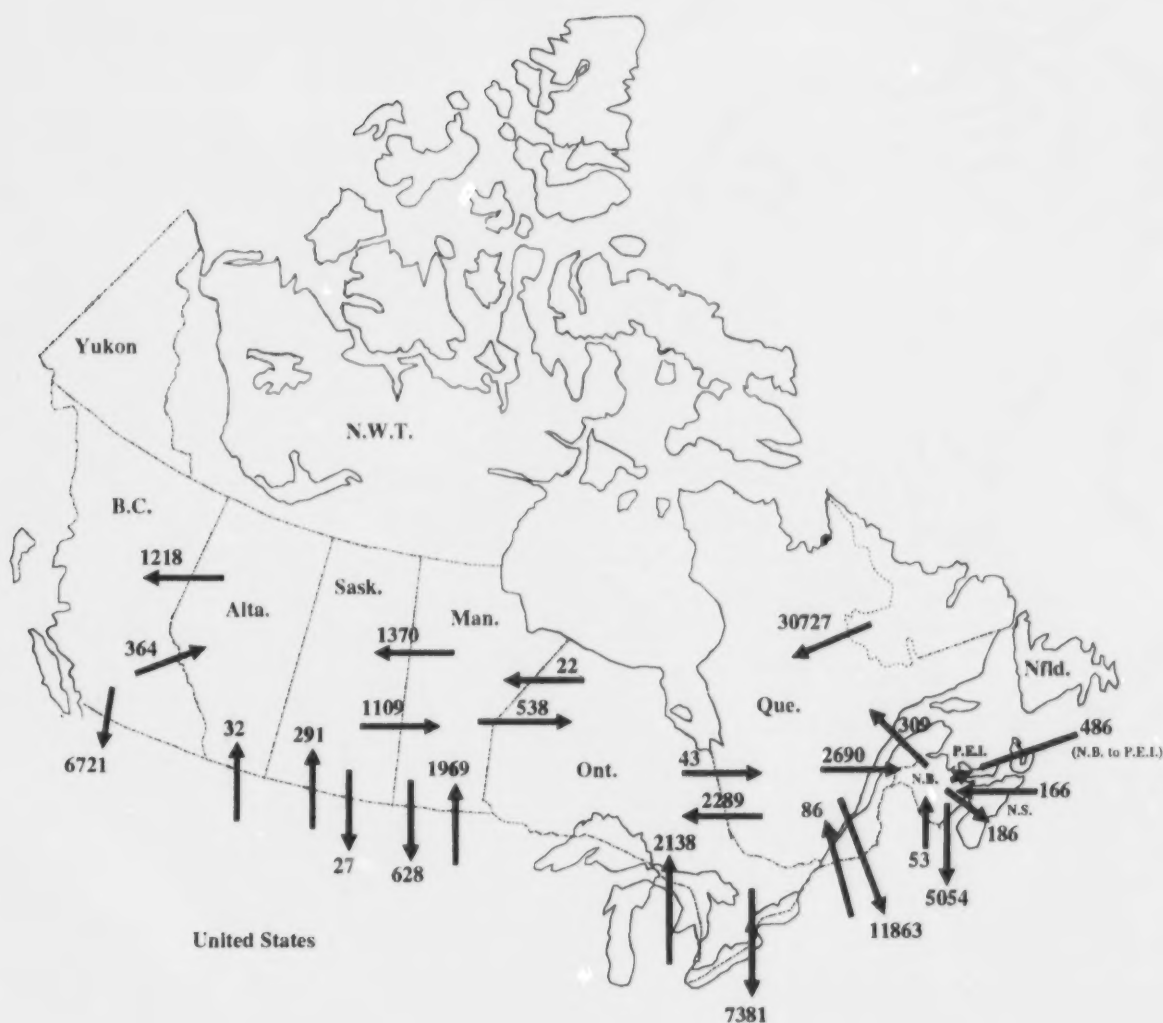
Exporting Province	Importing Market	Quantity (MW.h)	Value (\$1000)
New Brunswick	Maine	3 091 008	110 144
	Massachusetts	1 914 790	108 413
	New Hampshire	43 080	4 031
	New England	4 080	632
Quebec	Maine	903	51
	Massachusetts	278 899	11 932
	New Hampshire	10	1
	Vermont	1 789 215	65 480
	New England	3 931 267	111 407
	New York	5 863 932	156 810
Ontario	Vermont	400 848	14 681
	New York	4 835 344	145 523
	Michigan	382 804	10 248
	Minnesota	3 820	173
Manitoba	Minnesota	659 787	18 546
	North Dakota	63 675	1 619
Saskatchewan	North Dakota	1 475	27
British Columbia	Washington	1 067 410	24 475
	Oregon	2 997 293	42 406
	Idaho	74 310	1 471
	Montana	5 503	116
	California	2 269 248	51 253
	Nevada	41 403	836
	Utah	8 588	191
	Alaska	534	71
Canada	United States	29 729 226	880 537

* Excludes non-cash exchanges.

Source: National Energy Board.

Figure 6.3. Electricity trade, 1988 (GW.h)*

Interprovincial transfers:	49 201 GW.h
Exports to U.S.:	31 673 GW.h
Imports from U.S.:	4 470 GW.h



* Includes non-cash exchanges

Table 6.9. Provincial shares of Canadian electricity exports, 1960-1988*

Year	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Columbia	British Canada
1960	3.0	10.4	86.6	0.0	0.0	0.0	100.0
1961	4.9	9.8	84.8	0.0	0.0	0.5	100.0
1962	6.0	7.2	86.4	0.0	0.0	0.4	100.0
1963	6.8	0.7	91.8	0.0	0.0	0.7	100.0
1964	5.9	1.1	92.3	0.0	0.0	0.7	100.0
1965	6.4	1.3	84.0	0.0	0.0	8.3	100.0
1966	7.1	0.6	73.8	0.0	0.0	18.5	100.0
1967	8.4	0.6	77.7	0.0	0.0	13.3	100.0
1968	9.7	0.9	63.4	0.0	0.0	26.0	100.0
1969	11.2	0.7	66.7	0.0	0.0	21.4	100.0
1970	13.4	0.9	63.9	5.2	0.0	16.6	100.0
1971	18.2	0.9	55.5	9.4	0.0	16.0	100.0
1972	17.0	0.8	55.0	7.7	0.0	19.5	100.0
1973	17.5	0.4	47.0	6.1	0.0	29.0	100.0
1974	16.2	5.7	51.1	8.8	0.0	18.2	100.0
1975	14.2	8.0	42.5	10.3	0.0	25.0	100.0
1976	19.3	4.1	48.6	5.6	0.0	22.4	100.0
1977	17.8	2.9	48.3	2.9	0.0	28.1	100.0
1978	12.4	6.9	52.7	15.0	0.0	13.0	100.0
1979	12.9	25.4	40.2	13.4	0.0	8.4	100.0
1980	13.8	28.7	40.5	11.8	0.0	5.2	100.0
1981	9.3	24.0	33.2	10.3	0.0	23.2	100.0
1982	9.1	25.9	33.8	15.8	0.1	15.3	100.0
1983	14.2	27.5	33.9	16.0	0.2	8.2	100.0
1984	15.1	29.9	29.4	13.6	0.2	11.8	100.0
1985	14.8	23.1	22.5	13.6	0.3	25.7	100.0
1986	18.9	35.8	19.1	19.9	0.3	6.0	100.0
1987	13.0	36.2	15.9	7.3	0.1	27.5	100.0
1988	17.0	39.9	18.9	2.4	0.1	21.7	100.0

* Excludes non-cash exchanges.

Source: Energy, Mines and Resources Canada.

Table 6.10. Canadian energy trade, 1979-1988

	Oil	Natural gas	Coal	Electricity	Uranium	Total energy
(millions of dollars)						
1979						
Exports	4 265	2 889	750	729	379	9 614
Imports	<u>4 298</u>	<u>3</u>	<u>934</u>	<u>1</u>	<u>12</u>	<u>5 748</u>
Balance	-533	2 886	-184	<u>728</u>	<u>367</u>	<u>3 866</u>
1980						
Exports	4 891	3 984	824	773	231	11 328
Imports	<u>7 487</u>	<u>0</u>	<u>885</u>	<u>2</u>	<u>17</u>	<u>8 391</u>
Balance	-2 596	3 984	-61	<u>771</u>	<u>214</u>	<u>2 937</u>
1981						
Exports	5 228	4 370	1 065	1 123	178	12 636
Imports	<u>8 627</u>	<u>0</u>	<u>928</u>	<u>6</u>	<u>15</u>	<u>9 576</u>
Balance	-3 399	4 370	137	<u>1 117</u>	<u>163</u>	<u>3 060</u>
1982						
Exports	5 218	4 755	1 203	1 120	359	13 089
Imports	<u>5 763</u>	<u>1</u>	<u>1 017</u>	<u>5</u>	<u>17</u>	<u>6 793</u>
Balance	-545	4 754	186	<u>1 115</u>	<u>342</u>	<u>6 296</u>
1983						
Exports	6 338	3 958	1 247	1 228	63	13 201
Imports	<u>4 221</u>	<u>1</u>	<u>941</u>	<u>3</u>	<u>15</u>	<u>5 180</u>
Balance	2 117	3 957	306	<u>1 225</u>	<u>48</u>	<u>8 020</u>
1984						
Exports	7 580	3 886	1 851	1 379	334	15 718
Imports	<u>4 919</u>	<u>0</u>	<u>1 203</u>	<u>13</u>	<u>15</u>	<u>6 150</u>
Balance	2 661	3 886	648	<u>1 366</u>	<u>319</u>	<u>9 421</u>
1985						
Exports	9 239	3 912	2 030	1 408	232	17 411
Imports	<u>5 242</u>	<u>0</u>	<u>1 023</u>	<u>8</u>	<u>28</u>	<u>6 301</u>
Balance	3 997	3 912	1 007	<u>1 400</u>	<u>204</u>	<u>11 110</u>
1986						
Exports	5 854	2 483	1 869	1 080	842	12 128
Imports	<u>3 082</u>	<u>0</u>	<u>874</u>	<u>9</u>	<u>31</u>	<u>5 293</u>
Balance	2 772	2 483	995	<u>1 071</u>	<u>811</u>	<u>6 835</u>
1987						
Exports	8 029	2 527	1 696	1 211	886	13 349
Imports	<u>4 810</u>	<u>0</u>	<u>844</u>	<u>12</u>	<u>18</u>	<u>5 683</u>
Balance	3 219	2 527	852	<u>1 199</u>	<u>868</u>	<u>7 666</u>
1988						
Exports	6 396	2 930	1 963	889	673	12 851
Imports	<u>4 273</u>	<u>0</u>	<u>828</u>	<u>64</u>	<u>76</u>	<u>5 241</u>
Balance	2 123	2 930	1 135	<u>825</u>	<u>597</u>	<u>7 610</u>

Source: Statistics Canada, *Exports by Commodities (65-004) and Imports by Commodities (65-007)*.

Table 6.11. Annual Canadian interprovincial electricity trade, 1960-1988

Year	Total Canadian Generation (GW.h)	Delivered to other Provinces (GW.h)		Percentage of Interprovincial Transfers to Total Generation	
		With Churchill Falls	Without Churchill Falls	With Churchill Falls	Without Churchill Falls
1960	114 378	7 108	7 108	6.2	6.2
1961	113 713	7 411	7 411	6.5	6.5
1962	117 469	7 188	7 188	6.1	6.1
1963	122 238	6 586	6 586	5.4	5.4
1964	134 987	8 241	8 241	6.1	6.1
1965	144 274	6 230	6 230	4.3	4.3
1966	158 135	7 771	7 771	4.9	4.9
1967	165 625	6 874	6 874	4.2	4.2
1968	176 378	6 578	6 578	3.7	3.7
1969	191 102	6 338	6 338	3.3	3.3
1970	204 723	8 137	8 137	4.0	4.0
1971	216 472	8 047	7 870	3.7	3.6
1972	240 213	17 787	11 470	7.4	4.8
1973	263 335	28 933	15 129	11.0	5.8
1974	279 915	40 768	18 624	14.6	6.7
1975	273 392	49 198	19 684	18.0	7.2
1976	294 043	51 931	19 909	17.7	6.8
1977	316 940	52 005	18 739	16.4	5.9
1978	335 946	53 645	16 706	16.0	5.0
1979	353 051	49 847	14 642	14.1	4.2
1980	367 306	52 709	14 965	14.4	4.1
1981	380 131	51 181	15 325	13.5	4.0
1982	376 805	50 303	14 609	13.4	3.9
1983	395 850	46 007	14 863	11.6	3.8
1984	425 414	53 302	17 375	12.5	4.1
1985	446 413	51 663	19 917	11.6	4.5
1986	455 795	50 706	20 102	11.1	4.4
1987	482 108	49 201	18 808	10.2	3.9
1988	489 044	41 517	10 790	8.5	2.2

Source: Energy, Mines and Resources Canada.

Table 6.12. Interprovincial electricity trade by destination, 1979-1988

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	(GW.h)									
Newfoundland to Quebec	35 290	37 829	35 941	35 779	31 229	36 012	31 836	30 695	30 393	30 727
Nova Scotia to New Brunswick	151	226	112	133	121	271	190	71	82	166
New Brunswick to Nova Scotia	494	172	303	217	737	303	360	620	659	186
New Brunswick to P.E.I.	362	392	481	478	520	550	585	610	483	486
New Brunswick to Quebec	0	0	0	0	1	0	2	0	20	309
Quebec to New Brunswick	3 588	3 675	3 717	3 615	3 971	4 342	5 951	7 204	6 840	2 690
Quebec to Ontario	5 389	5 567	6 494	5 768	5 378	7 364	8 685	7 292	5 942	2 289
Ontario to Quebec	204	50	58	57	52	68	106	17	15	43
Ontario to Manitoba	23	0	0	3	13	2	0	5	3	22
Manitoba to Ontario	1 827	1 575	1 164	1 066	955	940	959	735	1 050	538
Manitoba to Saskatchewan	1 248	1 579	1 305	1 488	1 610	1 593	1 530	1 211	1 262	1 370
Saskatchewan to Manitoba	774	951	1 054	1 066	1 209	1 299	1 240	1 076	1 220	1 109
Saskatchewan to Alberta	0	4	3	3	2	3	0	0	0	0
Alberta to Saskatchewan	0	0	0	0	4	0	0	0	0	0
Alberta to B.C.	394	385	261	188	46	259	182	617	710	1 218
B.C. to Alberta	103	100	165	442	163	296	37	553	521	364
Total	49 847	52 709	51 181	50 303	46 007	54 302	51 663	50 706	49 201	41 517

Source: Energy, Mines and Resources Canada.

7. TRANSMISSION

Total circuit length of electrical transmission in Canada, for lines rated at 50 kV and above, increased by 1123 km in 1988. The total length of Canadian bulk transmission is now 149 427 km. The largest share (32 per cent) is in the 100 kV to 149 kV range (Table 7.1).

To facilitate energy exchanges and enhance the reliability of electrical systems operation, there are now 35 major provincial interconnections, with a total design capability of about 10 000 MW (Table 7.2). One important interconnection under construction is a \$41 million high-voltage-direct-current (HVDC) transmission line linking the electrical systems of Saskatchewan and Alberta. This interconnection will run from Swift Current, Saskatchewan, to Empress, Alberta, and will be the first Canadian link between the eastern and western power systems of North America.

There are now over 100 international transmission lines in place to provide for Canada's international trade in electricity. Although most of these lines are

quite small, there are 36 bulk power interties rated at 69 kV or higher, with a total power transfer capability of 17 500 MW (Table 7.3).

Canada is a world leader in long-distance electric power transmission, in both extra-high-voltage (EHV) alternating current and HVDC. A major influence on the development of Canada's expertise in these areas has been the country's abundant water power resources. Early in the century, pioneering efforts in high-voltage transmission resulted in the initial development of hydroelectric power at Niagara Falls, to supply the growing needs of communities in southern Ontario. In Quebec, the first 50-kV transmission lines were constructed to bring power from Shawinigan to Montreal.

After the harnessing of the major hydroelectric sites close to load centres, it became necessary to develop remote hydroelectric sources in several provinces and to integrate these sources into the power system over long-distance

EHV and HVDC transmission lines. In 1965, Hydro-Québec installed the world's first 735-kV class transmission system. This system now extends over 1100 km from the Churchill Falls development in Labrador to Montreal; a comparable system of about the same distance extends from the James Bay development to Quebec's load centres.

In Manitoba, pioneering work was done to develop the ± 450 -kV HVDC system, which now brings hydroelectric power from the Nelson River generating stations to customers in southern Manitoba. Ontario and British Columbia also have extensive EHV systems in the 500-kV class (Figure 7.1).

Such advances in Canadian transmission techniques have provided not only for long-distance bulk transmission, but also for extensive interconnections between neighbouring provinces and between Canada and the United States.

Table 7.1. Transmission circuit length in Canada, 1988

	50 - 99 kV	100 - 149 kV	150 - 199 kV	200 - 299 kV	300 - 399 kV	400 - 599 kV	600 kV and up	Total
			(km)					
Nfld.	2 230	1 906	-	2 005	-	-	612	6 753
P.E.I.	371	169	-	-	-	-	-	540
N.S.	2 026	1 676	-	1 067	96	-	-	4 865
N.B.	2 783	1 900	-	528	969	-	-	6 180
Que.	4 221	7 694	2 190	3 685	7 257	78	10 092	35 217
Ont.	247	12 312	-	13 666	6	2 411	-	28 642
Man.	6 651	4 256	-	4 157	-	2 042	-	17 106
Sask.	4 849	4 081	-	2 594	-	-	-	11 524
Alta.	3 440	8 748	159	5 802	-	356	-	18 505
B.C.	4 799	4 235	264	3 759	403	5 344	-	18 804
Yukon	64	497	-	-	-	-	-	561
N.W.T.	227	503	-	-	-	-	-	730
Canada	31 908 (21%)	47 977 (32%)	2 613 (2%)	37 263 (25%)	8 731 (6%)	10 231 (7%)	10 704 (7%)	149 427 (100%)

Source: Statistics Canada publication 57-202. Energy, Mines and Resources Canada.

Figure 7.1. Canada's major long-distance transmission systems, 1988



Table 7.2. Provincial interconnections at year end, 1988

Connection	Voltage	Design Capability*
	(kV)	(MW)
British Columbia - Alberta	1 x 500	800
	1 x 138	110
Saskatchewan - Manitoba	3 x 230	400
	2 x 110	100
Manitoba - Ontario	2 x 230	260
	1 x 115	
Ontario - Quebec	4 x 230	1 300
	7 x 120	
Quebec - Newfoundland	3 x 735	5 225
Quebec - New Brunswick	2 x ± 80 (DC)	700
	2 x 345	
	2 x 230	300
New Brunswick - Nova Scotia	2 x 138	600
	1 x 345	
New Brunswick - P.E.I.	2 x 138	200

* Actual transfer capability in practice will be different from design capability.

Source: Energy, Mines and Resources Canada.

Figure 7.2. Major provincial and international interconnections, 1988

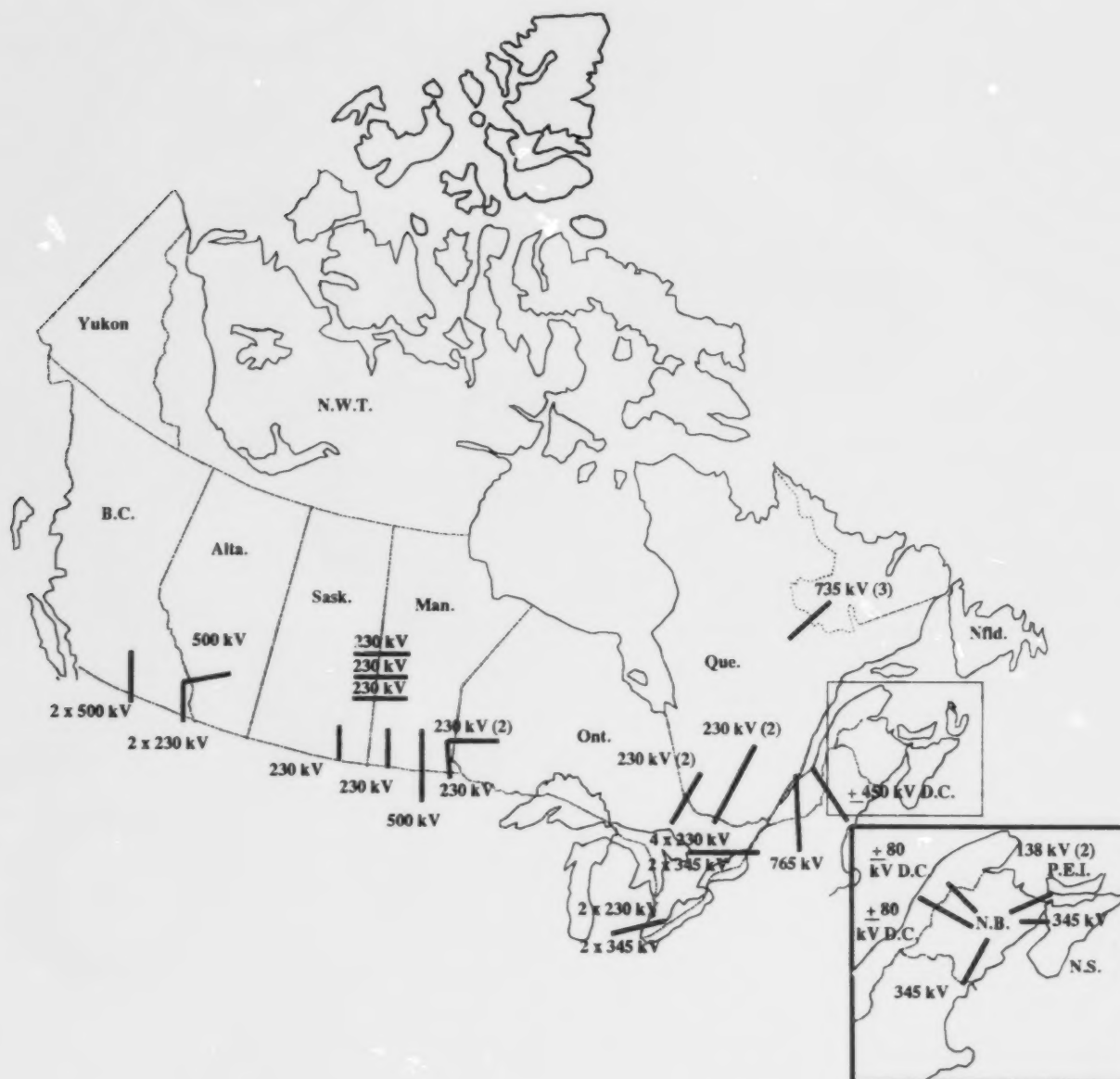


Table 7.3. Major interconnections between Canada and the United States*

Province	State	Voltage	Design Capability***
		(kV)	(MW)
New Brunswick	Maine	1 x 345 1 x 138 5 x 69	600 60 155
Quebec	New York	1 x 765	2 300
	New York	2 x 120	300
	Vermont	2 x 120	275
	New Hampshire	± 450(DC)	690
Ontario**	New York	1 x 230 1 x 230 2 x 230 2 x 345 2 x 69 2 x 115	470 400 600 2 300 132 200
	Michigan	1 x 230 1 x 230 2 x 345	535 515 1 470
	Minnesota	1 x 120	35
Manitoba	North Dakota	1 x 230	150
	Minnesota	1 x 230	175
	Minnesota	1 x 500	1 000
Saskatchewan	North Dakota	1 x 230	150
British Columbia**	Washington	1 x 230 1 x 230 2 x 500	300 400 4 300

* 35 MW capacity or over.

** The transfer capability of several lines may not be equal to the mathematical sum of the individual transfer capabilities of the same lines.

*** Actual transfer capability in practice will be different from design capability.

Source: Energy, Mines and Resources Canada.

8. ELECTRIC UTILITY INVESTMENT AND FINANCING

The electric power industry is inherently capital-intensive. Between 1961 and 1987, the average capital-output ratio for the industry has been about 12.8, compared with 2.0 for the economy as a whole.

Due to stronger-than-expected domestic demand in the past two years, electric utilities increased their capital spending by more than \$1 billion in 1988 over 1987 (Table 8.1). The latest survey of new plant and equipment spending indicates that Canada's electric utilities plan to raise outlays by 10 per cent in 1989 (Table 10.8).

The electric power industry continues to be the largest investment contributor in the Canadian energy sector (Table 8.2). Between 1971 and 1988, capital investment in generation accounted for about 57 per cent of total capital expenditures (Table 8.3). In 1988, Ontario Hydro and Hydro-Québec had the largest investment programs (Table 8.4).

Canada's electric utilities rely heavily on foreign financial markets to finance their capital investment. As of December 31, 1987, the total outstanding long-term debt of major electric utilities in Canada was \$67 billion. Of this total, about 57

per cent (or \$38 billion) was borrowed on the domestic market, and 43 per cent (or \$29 billion) on international markets. Eighty-six per cent was raised in the United States; 7 per cent (\$1.9 billion) in Switzerland; 4 per cent (\$1.1 billion) in West Germany; 2 per cent (\$0.7 billion) in Japan; and the remaining 1 per cent (\$0.4 billion) in other European countries (Table 8.5).

In Canada and the United States, publicly owned electric utilities depend mainly on debt-financing. Investor-owned utilities, on the other hand, rely much more extensively on equity-financing (Table 8.6).

Table 8.1. Electric utility capital investment, 1971-1988

	Investment in electric power industry (\$ million)	As a percentage of total energy investment	As a percentage of total investment in the economy	As a percentage of GDP
1971	1 747	52	8	1.8
1972	1 754	49	7	1.6
1973	2 244	53	8	1.8
1974	2 753	53	8	1.8
1975	3 957	58	9	2.3
1976	4 229	55	9	2.1
1977	4 884	56	10	2.2
1978	5 936	58	11	2.5
1979	6 364	53	10	2.3
1980	6 109	42	8	2.0
1981	7 319	40	9	2.1
1982	8 408	39	10	2.2
1983	7 770	42	10	1.9
1984	6 340	37	8	1.4
1985	5 729	34	6	1.2
1986	5 618	41	6	1.1
1987	6 233	47	5	1.1
1988	7 308	44	6	1.2

Source: Energy, Mines and Resources Canada.

Figure 8.1. Capital investment by function, 1988

Total Investment: \$7.3 billion

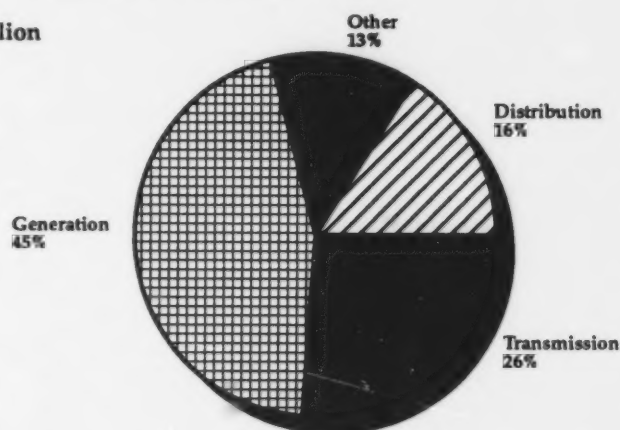


Table 8.2. Investment in energy-related industries, 1971-1988

Year	Crude oil and natural gas	Refined petroleum and coal products	Natural gas distribution	Electric power	Coal mines	Uranium mines	Other*	Total
(millions of dollars)								
1971	463	231	115	1 747	90	6	702	3 381
1972	666	244	142	1 754	37	11	683	3 567
1973	824	319	146	2 244	39	18	589	4 220
1974	1 088	430	192	2 753	88	35	546	5 151
1975	1 390	450	193	3 957	121	30	662	6 831
1976	1 868	344	182	4 229	191	66	666	7 676
1977	2 251	367	213	4 884	248	113	666	8 782
1978	2 271	315	247	5 936	219	180	745	10 258
1979	3 886	274	263	6 364	214	243	793	12 037
1980	5 745	325	386	6 109	299	277	1 317	14 458
1981	6 445	848	409	7 319	576	289	2 285	18 419
1982	6 743	1 231	518	8 408	1 024	405	2 389	21 339
1983	6 564	841	577	7 770	1 225	413	1 190	18 715
1984	6 947	432	604	6 340	832	186	1 262	16 943
1985	8 184	336	604	5 729	471	160	1 101	16 925
1986	5 401	398	574	5 618	429	144	962	13 733
1987	4 331	660	534	6 233	355	106	1 168	13 348
1988	5 967	762	533	7 308	368	159	1 278	16 599

* Natural gas processing plants, transportation, marketing, and oil and gas drilling contractors.

Source: Energy, Mines and Resources Canada.

Table 8.3. Capital investment by function, 1971-1988

Year	Generation	Transmission	Distribution	Other	Total
(millions of current dollars)					
1971	915	520	239	73	1 747
1972	1 020	432	229	73	1 754
1973	1 252	366	286	340	2 244
1974	1 805	388	422	138	2 753
1975	2 460	616	547	334	3 957
1976	2 576	794	464	395	4 229
1977	3 085	907	519	373	4 884
1978	3 499	1 290	499	648	5 936
1979	3 892	1 266	570	636	6 364
1980	3 580	1 114	703	712	6 109
1981	4 552	1 387	647	733	7 319
1982	5 026	1 436	937	1 009	8 408
1983	4 882	1 270	766	852	7 770
1984	3 530	1 158	834	818	6 340
1985	2 941	836	1 008	944	5 729
1986	3 214	815	989	600	5 618
1987	2 908	1 258	1 089	978	6 233
1988	3 289	1 900	1 169	950	7 308

Source: Energy, Mines and Resources Canada.

Table 8.4. Capital investment by major electric utility

	1987	1988	Year-over-year change
	(millions of current dollars)		
Newfoundland and Labrador Hydro	45	97	52
Newfoundland Light & Power	31	38	7
Maritime Electric Co. Ltd.	13	10	-3
Nova Scotia Power	101	217	116
NB Power	82	127	45
Hydro-Québec	1 688	2 107	419
Ontario Hydro	2 638	2 900	262
Manitoba Hydro	298	381	83
Saskatchewan Power	125	200	75
Alberta Power	133	124	-9
Edmonton Power	187	235	48
TransAlta Utilities	164	223	59
B.C. Hydro	142	238	96
Yukon Energy Corporation	1	3	2
Northwest Territories Power Corporation	8	27	19
Canada	5 656	6 927	1 271

Source: *Energy, Mines and Resources Canada.*

Table 8.5. Major electric utility long-term debt and sources of financing, 1987

	Long-Term Debt (\$ millions)	Sources of Long-Term Debt Financing	
		Domestic (%)	Foreign (%)
Newfoundland and Labrador Hydro	1 425	52	48
Newfoundland Light & Power	141	93	7
Maritime Electric Co. Ltd.	18	100	0
Nova Scotia Power	1 372	74	26
NB Power	2 124	38	62
Hydro-Québec	22 102	41	59
Ontario Hydro	25 064	62	38
Manitoba Hydro	3 443	37	63
Saskatchewan Power	2 288	70	30
Alberta Power	480	100	0
Edmonton Power	722	100	0
TransAlta Utilities	1 084	95	5
B.C. Hydro	7 070	51	49
Northern Canada Power Commission	96	100	0
Canada	67 429	57	43

Source: Energy, Mines and Resources Canada.

Table 8.6. Comparison of Canadian and U.S. electric utility debt ratios, 1984 - 1987

	1984	1985	1986	1987
CANADA	(per cent)			
Publicly owned utilities				
Newfoundland and Labrador Hydro	91	90	88	86
Nova Scotia Power	94	95	96	98
NB Power	89	88	84	85
Hydro-Québec	75	76	76	75
Ontario Hydro	83	84	84	84
Manitoba Hydro	97	96	96	97
Winnipeg Hydro	67	68	71	72
Saskatchewan Power	86	87	88	87
Edmonton Power	84	80	75	75
B.C. Hydro	87	86	88	86
Northern Canada Power Commission	95	96	82	77
Investor-owned utilities				
Newfoundland Light & Power	44	45	43	48
Maritime Electric Co. Ltd.	48	43	42	43
TransAlta Utilities Corporation	33	33	38	35
Alberta Power	31	29	32	39
UNITED STATES				
Publicly owned utilities				
Tennessee Valley Authority	84	83	83	83
Bonneville Power Administration	100	100	100	100
Power Authority of the State of New York	69	71	72	74
Investor-owned utilities				
Boston Edison Company	50	51	46	48
Northeast Utilities	52	53	52	53
Consolidated Edison Company of New York	34	36	36	37
Niagara Mohawk Power Corporation	46	46	47	55
American Electric Power Company	54	53	53	54
Northern States Power Company	46	46	46	43
Washington Water Power Company	48	44	48	48
Pacific Gas and Electric Company	46	48	46	49

Source: Energy, Mines and Resources Canada.

9. COSTING AND PRICING

During the past 26 years, increases in the cost of building electric power stations have been relatively small, with the exception of the period 1973-1982 (Table 9.1).

Between 1973 and 1982, there were two key reasons for the rapid increases in the cost of electricity: the high rate of inflation, with an average increase of about 10 per cent; and the increased cost of fossil fuels,

with an average annual increase of 18 per cent. High levels of inflation affect the electric utility industry by increasing the cost of constructing additional facilities and by increasing the cost of borrowed funds.

Table 9.1. Inflation, interest rates, and construction costs, 1960-1988

	Average Interest Rate	Increase in Construction Costs			CPI
		Hydro	Steam	Nuclear	
		(per cent)			
1960	5.7	-	-	-	-
1961	5.4	-	-	-	-
1962	5.4	2.8	-	-	1.2
1963	5.5	3.3	-	-	1.7
1964	5.5	3.2	-	-	1.8
1965	5.7	5.0	-	-	2.5
1966	6.4	6.2	-	-	3.7
1967	6.7	3.6	1.1	-	3.5
1968	7.8	4.2	2.8	-	4.7
1969	8.6	5.7	6.8	-	4.5
1970	9.3	6.6	7.4	-	3.3
1971	8.5	4.6	6.0	-	2.9
1972	8.4	6.3	6.1	6.9	4.8
1973	8.6	9.2	9.2	9.5	7.6
1974	10.2	18.8	20.5	19.2	10.9
1975	10.7	14.3	13.4	13.1	10.8
1976	10.4	8.9	10.0	9.7	7.5
1977	9.6	5.9	7.9	7.5	8.0
1978	10.0	7.7	8.7	8.0	9.0
1979	10.9	8.7	11.0	12.7	9.2
1980	13.3	10.0	11.6	22.0	10.2
1981	16.3	13.7	11.9	11.4	12.5
1982	15.9	7.2	6.8	5.3	10.8
1983	12.8	4.6	4.1	5.0	5.8
1984	12.5	3.2	2.8	0.1	4.4
1985	11.7	1.7	3.8	4.8	4.0
1986	10.5	4.1	3.5	3.5	4.1
1987	10.9	4.1	3.0	1.9	4.1
1988	11.0	4.0	5.7	2.8	4.0

Source: Interest rates - McLeod Young Weir Ltd.

Construction costs and CPI - Statistics Canada publications 62-007 and 62-001.

Fuel costs for electricity generation were generally stable until the oil crisis of 1973 (Table 9.2). The increases after 1973 were particularly significant for oil-fired generation. The cost of fuel generated from coal varies between regions of the country and depends on the type of coal used, its source, and the percentage of total energy supply derived from fossil-fuel plants.

In general, the cost of coal in western Canada has been substantially less than that in eastern Canada. The coal used for electricity generation in western Canada is produced domestically, while a large proportion of the coal used in eastern Canada is imported.

Electricity rates in Canada vary significantly from province to province (Table 9.3). In 1988, the weighted electricity-rate increase was 3.5 per cent, which is slightly less than the general inflation rate of 4.0 per cent, as measured by the Consumer Price Index (Table 9.6). Electricity prices in Canada continue to compare favourably with other industrialized countries.

Table 9.2. Cost of fuel for electricity generation, 1969-1987

	Eastern Coal*	Western Coal**	Petroleum	Natural Gas	Uranium	Total Fuels
	(mills/kW.h)					
1969	3.46	1.11	4.97	2.54	-	3.24
1970	3.60	1.38	5.68	2.47	-	3.25
1971	4.20	1.28	5.98	3.15	-	3.46
1972	4.32	1.34	6.41	3.93	-	3.42
1973	4.65	1.43	7.06	3.74	-	3.13
1974	5.38	1.54	11.36	5.18	-	4.10
1975	8.64	2.07	12.87	7.17	-	6.16
1976	11.43	2.97	15.38	11.74	1.14	8.11
1977	11.89	3.20	19.01	15.21	1.34	8.40
1978	13.12	2.88	21.22	16.19	1.61	8.82
1979	16.50	3.11	23.93	15.22	1.65	9.62
1980	18.22	3.75	26.22	15.47	2.65	10.69
1981	20.48	4.83	40.77	23.22	2.68	12.22
1982	22.61	5.76	44.88	30.16	2.87	14.04
1983	23.71	5.96	57.27	31.17	3.25	13.20
1984	24.85	5.94	65.11	34.15	3.84	13.64
1985	26.07	6.59	68.02	31.81	4.74	13.54
1986	25.88	5.13	45.15	27.11	4.52	10.70
1987	25.07	5.84	37.22	22.20	4.77	11.63

* Nova Scotia, New Brunswick, and Ontario.

** Alberta, Saskatchewan, and Manitoba.

Source: Calculated from *Electric Power Statistics*, Statistics Canada, Catalogue 57-202, various issues.

Table 9.3. Average revenue from electricity sales by province, 1978-1987

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(current cents/kW.h)									
Nfld.	2.0	2.2	2.3	2.8	3.6	3.7	3.9	4.7	3.9	4.0
P.E.I.	6.4	7.2	8.1	10.0	12.0	12.3	12.8	12.9	11.5	10.3
N.S.	4.4	4.6	4.5	4.9	5.9	6.9	7.5	7.3	6.9	6.8
N.B.	3.2	3.7	4.1	4.8	5.1	5.4	5.5	5.8	5.5	5.5
Que.	1.7	2.0	2.2	2.6	3.1	3.4	3.4	3.5	3.4	3.4
Ont.	2.4	2.6	2.9	3.2	3.6	3.9	4.2	4.5	4.5	4.9
Man.	2.3	2.7	2.8	2.8	2.9	3.1	3.4	3.6	3.6	3.9
Sask.	2.7	2.7	2.9	3.6	4.0	4.2	4.5	4.8	5.0	5.5
Alta.	3.1	3.2	3.4	4.1	4.9	5.2	5.4	5.4	5.4	5.3
B.C.	2.2	2.4	2.6	3.0	3.8	3.8	4.1	4.4	4.2	4.2
Yukon	4.4	4.9	5.3	6.7	8.3	8.3	8.6	9.0	7.8	7.4
N.W.T.	7.7	9.0	10.0	11.5	14.8	17.9	16.7	16.3	15.9	17.6
Canada	2.3	2.5	2.8	3.1	3.7	3.9	4.1	4.3	4.2	4.4

Source: Statistics Canada publication 57-202.

Table 9.4. Major electric utilities' statements of income, 1987

	Total Revenue	O & M	Fuel Costs	Power Purchased	Depre- ciation	Taxes	Interest	Exchange Losses	Other Costs	Net Income
(millions of current dollars)										
Newfoundland and Labrador										
Hydro	332	55	61	-	23	-	149	-	-	44
Newfoundland Light & Power	251	42	-	144	17	11	17	-	-	20
Maritime Electric Co. Ltd.	61	11	-	32	4	5	4	-	-	5
Nova Scotia Power	510	75	199	13	52	5	152	-	42	(28)
NB Power	867	92	175	132	82	-	259	-	91	36
Hydro-Québec	5 095	1 246	-	110	500	289	2 170	272	-	508
Ontario Hydro	5 280	1 150	1 124	117	723	90	1 702	126	(23)	271
Manitoba Hydro	580	240	-	35	80	26	250	3	-	(18)
Winnipeg Hydro	92	24	-	39	3	2	8	-	1	5
Saskatchewan Power	859	218	253	-	101	-	251	-	-	36
Alberta Power	409	22	131	-	49	82	70	-	-	55
Edmonton Power	280	44	-	77	18	22	5	-	48	66
TransAlta Utilities	925	185	-	21	144	245	129	-	22	179
B.C. Hydro	2 110	318	281	-	237	306	875	-	38	55
Northern Canada Power Commission	76	57	-	-	8	-	7	-	-	4
Canada	17 727	3 743	2 224	720	2 041	1 083	6 048	401	219	1 248

Source: Obtained from electric utilities' annual reports, 1987.

Table 9.5. Monthly electricity costs, January 1988 (Dollars)*

Sector:	Residential	Commercial	Industrial
Billing Demand (kW):	—	100	1000
Consumption (kW.h):	1000	25 000	400 000
St. John's	70.58	1 925.86	22 610.07
Charlottetown	101.70	3 284.55	37 937.55
Halifax	72.61	2 261.50	23 365.48
Moncton	64.50	2 006.30	20 450.00
Montreal	44.11	1 506.60	18 025.40
Ottawa	51.20	1 336.90	19 021.90
Toronto	59.90	1 820.25	22 104.00
Winnipeg	43.48	1 148.81	13 821.31
Regina	60.73	1 874.64	23 822.14
Calgary	50.12	1 437.09	16 593.47
Edmonton	51.54	1 565.15	20 002.24
Vancouver	53.32	1 332.85	16 071.30
Whitehorse	72.30	2 280.00	—
Yellowknife	103.53	2 762.50	40 692.50

* Bills computed are on a net basis and exclude all taxes.

Source: Statistics Canada publication 57-203.

Table 9.6. Average annual rate increases, 1979-1988

	Rate Changes (%): Average of all Customer Classes									
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Newfoundland and Labrador Hydro	-	19.0	15.8	-	18.2	-	-	-1.7	-	-
Newfoundland Light & Power	12.4	11.8	14.6	-	12.0	-	-	8.7	3.0	-1.1
Maritime Electric Co. Ltd.	-	13.1	21.4	-**	-**	-	3.7	-3.8	-	-1.3
Nova Scotia Power	12.5	(b)	36.6	-	-	-	-	-	-	-
NB Power	7.9	7.8	9.8	-	8.8	6.2	4.6	-	-	-
Hydro-Québec	13.7	13.3	10.6	16.3	7.3	4.0	4.0	5.4	4.9	3.9
Ontario Hydro	7.7	7.3	10.0	10.0	8.2	7.5	8.6	4.0	5.0	4.7
Manitoba Hydro	14.4	(a)	-	-	9.5	7.9	5.0	2.8	9.7	4.5
Saskatchewan Power	8.3	7.9	16.1	7.5	12.6	9.2	-	7.5	7.5	6.1
Edmonton Power	-	26.0	12.0	13.2	8.0	5.0	6.7	0	3.0	1.9
TransAlta Utilities	7.5	-	13.0	4.0	15.0	-	1.7	6.1	-1.8	-1.0
Alberta Power	-	12.3	28.9	-11.6*	2	-	-4.3	-8.6	-5.0	14.5
B.C. Hydro	5.5	7.6	2.6	20.0*	6.0	6.5	3.8	1.8	-	-

(a) The provincial government froze rates from 1979 until 1983.

(b) The provincial government froze rates in 1980.

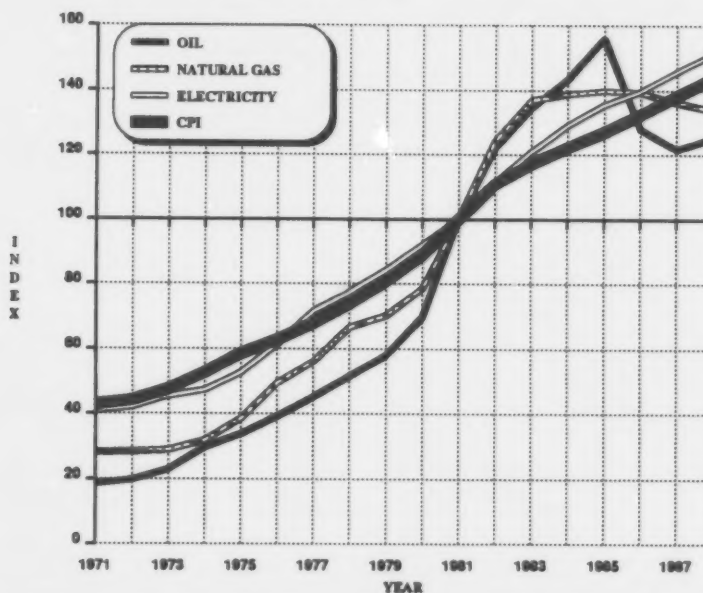
* Based on residential category.

** Does not reflect monthly changes to the cost of commodity and fuel adjustment charges.

Source: Energy, Mines and Resources Canada.

Figure 9.1. Price indices, 1971-1988

1981 = 100



10. ELECTRICITY OUTLOOK

Forecasting electricity demand has become a difficult task in recent years. This is largely a result of the economic dislocation caused by rapidly rising energy prices, particularly between 1975-77 and 1980-82. The effects of higher energy prices have been felt globally, and adjustments have been made worldwide in the amount, types, and uses of energy. The collapse of world oil prices in 1986 has added to the uncertainty. Adjustments in energy-use patterns continue to make economic forecasting difficult, and this economic uncertainty, in turn, leads to uncertainty about future electricity demand.

Despite this uncertainty, forecasts of electricity demand are essential to ensure that sufficient generating capacity is available when it is needed. The long lead time in the construction of new generating facilities makes it necessary for utilities to calculate future demand many years in advance.

Based on the electric utilities' own projections, electricity demand for Canada as a whole is estimated to be 2.2 per cent during the period 1988-2005 (Table 10.1). The National Energy Board's forecast is 2.0 per cent for the same period, compared with the Department of Energy, Mines and Resources'

forecast of 2.4 per cent (Figure 10.1). These forecasts are much lower than the historic average of 6 per cent for the 1947-1988 period.

The electric utilities project that peak demand will be about 2.3 per cent for the period 1988-2005 (Table 10.2). Since peak demand is expected to grow slightly faster than energy demand, the load factor for Canada as a whole is expected to decrease from 67.2 per cent in 1988 to 66.8 per cent by 2005 (tables 10.1 and 10.2). To meet the forecast growth in electricity demand, the electric utilities project net additions of generating capacity of 31 287 MW between 1988 and 2005, or

Table 10.1. Forecasts of domestic electricity demand

	1988	1990	1995	2000	2005	Average Annual Growth Rate 1988-2005
			(GWh)			(%)
Nfld.	10 423	11 575	12 723	14 156	15 698	2.4
P.E.I.	704	747	822	883	950	1.8
N.S.	8 912	10 057	11 653	13 049	14 480	2.9
N.B.	12 646	13 757	15 987	17 934	19 857	2.7
Quebec	163 328	171 296	192 443	206 848	214 109	1.6
Ontario	140 677	144 288	161 662	175 463	191 529	1.8
Man.	16 867	17 996	20 072	22 029	23 889	2.1
Sask.	13 455	14 477	16 670	18 373	19 686	2.3
Alta.*	39 325	43 952	58 452	75 280	95 306	5.3
B.C.	54 078	57 065	62 840	68 595	74 872	1.9
Yukon	439	430	437	440	444	0.1
N.W.T.	466	496	501	507	512	0.6
Canada	461 320	486 136	554 262	613 557	671 332	2.2

* Alberta Interconnected System provided high and low load-growth scenarios. The high-growth case is used.

Source: Canadian electric utilities, and National Energy Board.

an average of 1840 MW per year (Table 10.3). Of the total net additions, hydro is expected to account for 64 per cent (20 021 MW); coal 14 per cent (4417 MW); nuclear 9 per cent (2391 MW); oil 3 per cent (974 MW); and other 2 per cent (549 MW) (Table 10.4).

Future electricity generation is still projected to be dominated by hydro. By the year 2005, the electric utilities project that hydro will account for 58 per cent of total electricity generation; coal 21 per cent; nuclear 16 per cent; natural gas 3 per cent; oil and other 1 per cent each (Table 10.6).

Between 1988 and 2005, the use of natural gas, coal and uranium for electricity generation is expected to increase, while the use of oil is expected to decline (Table 10.7).

Over the next ten years (1989-1998), major utilities in Canada are expected to invest about \$115 billion. Of this total, investment in generation will account for 52 per cent (\$60 billion); transmission 24 per cent (\$27 billion); distribution 14 per cent (\$16 billion); and other 10 per cent (\$12 billion) (tables 10.8 and 10.9).

Electricity exports to the United States are expected to grow steadily to the year 2005 (Table 10.10)

Figure 10.1. Comparison of electricity demand forecasts

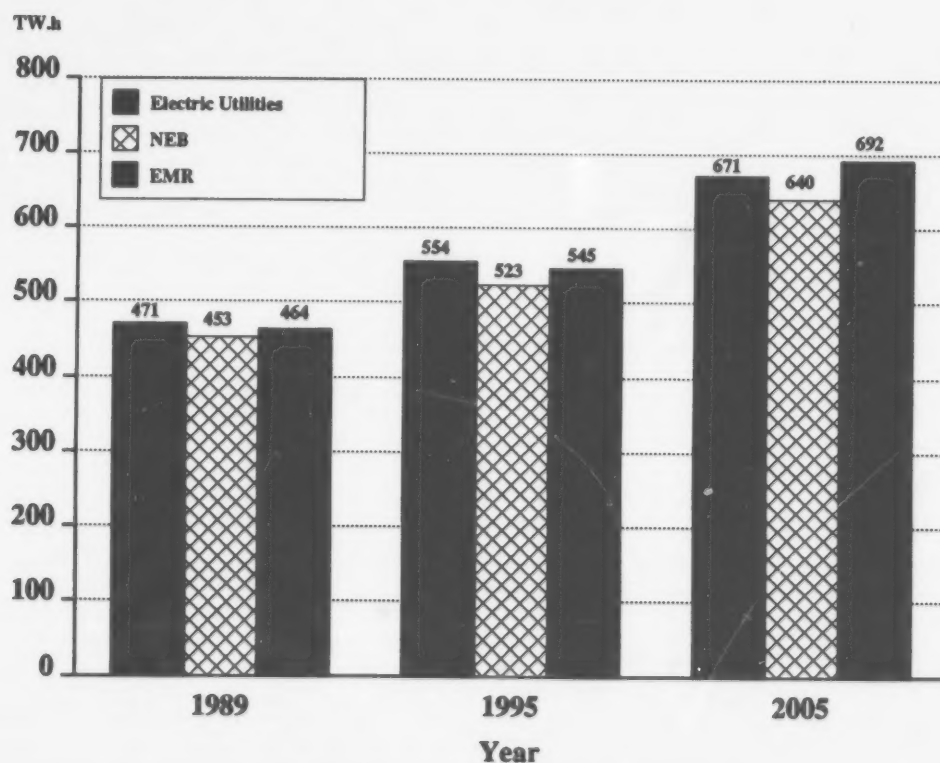


Table 10.2. Forecasts of domestic peak demand

	1988	1990	1995	2000	2005	Average Annual Growth Rate 1988-2005
			(MW)			(%)
Nfld.	1 740	1 844	2 046	2 338	2 586	2.4
P.E.I.	127	136	148	157	167	1.6
N.S.	1 706	1 919	2 243	2 549	2 849	3.1
N.B.	2 525	2 689	3 154	3 544	3 923	2.6
Quebec	28 688	28 374	33 084	37 832	42 571	2.3
Ontario	23 816	24 142	26 679	28 529	30 927	1.6
Man.	3 437	3 524	3 952	4 313	4 666	1.8
Sask.	2 280	2 519	2 904	3 199	3 439	2.5
Alta.	5 823	6 801	8 644	10 693	11 394	4.0
B.C.	8 054	8 914	9 904	10 904	12 019	2.4
Yukon	75	78	79	79	79	0.3
N.W.T.	111	115	117	120	121	0.5
Canada	78 382	81 055	92 954	104 257	114 741	2.3

Source: Canadian electric utilities, and National Energy Board.

Table 10.3. Forecasts of installed generating capacity by province

	1988	1990	1995	2000	2005	Average Annual Growth Rate 1988-2005
			(MW)			(%)
Nfld.	7 426	7 373	8 243	8 252	8 311	0.7
P.E.I.	142	124	124	124	124	-0.8
N.S.	2 345	2 051	2 531	2 991	3 291	2.0
N.B.	3 471	3 480	4 180	4 630	4 630	1.7
Quebec	27 258	28 542	31 909	38 369	41 444	2.5
Ontario	32 955	32 685	34 080	35 111	35 171	0.4
Man.	4 125	4 332	5 321	5 707	6 357	2.6
Sask.	2 845	2 828	3 328	3 683	4 063	2.1
Alta.	7 600	7 759	9 260	11 622	13 941	3.6
B.C.	12 497	12 371	12 371	13 451	14 566	0.9
Yukon	145	149	159	179	184	1.4
N.W.T.	175	180	184	189	189	0.5
Canada	100 984	101 874	111 690	124 308	132 271	1.6

Source: Canadian electric utilities, and National Energy Board.

Figure 10.2. Comparison of generating capacity forecasts

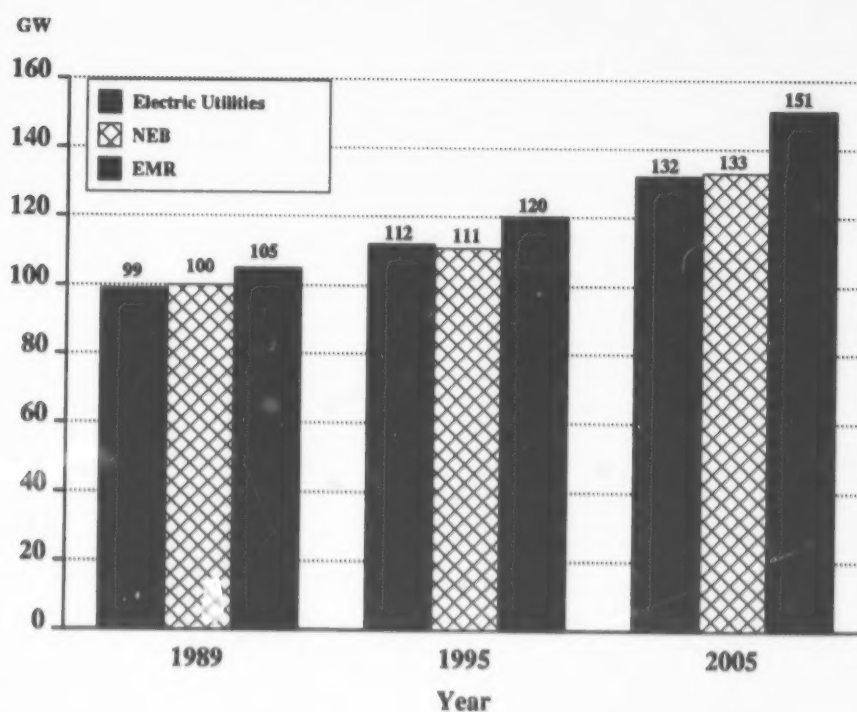


Table 10.4. Forecasts of installed generating capacity by fuel type in Canada

	1988	1990	1995	2000	2005
(MW)					
Coal	19 183	18 852	20 218	22 201	23 600
Oil	7 311	7 224	8 029	8 223	8 285
Natural gas	3 782	3 776	3 827	5 067	6 177
Nuclear	12 586	12 874	15 517	15 517	15 517
Hydro	57 484*	58 568	63 187	72 225	77 505
Other	638	580	912	1 075	1 187
Total	100 984	101 874	111 690	124 308	132 271

* Includes tidal power.

Source: Canadian electric utilities, and National Energy Board.

Table 10.5. Utility forecasts of electricity generation by province

	1988	1990	1995	2000	2005	Average Annual Growth Rate 1988-2005
			(GW.h)			(%)
Nfld.	41 150	44 312	44 909	45 087	46 981	0.8
P.E.I.	218	225	225	225	225	0.2
N.S.	8 892	9 875	11 643	12 761	14 480	2.9
N.B.	15 772	15 196	20 131	22 552	24 023	2.5
Quebec	149 005	151 053	176 938	175 178	209 627	2.0
Ontario	142 743	147 846	165 610	166 476	191 904	1.8
Man.	16 308	22 688	28 999	32 290	33 630	4.3
Sask.	12 937	13 949	16 077	17 990	19 471	2.4
Alta.	40 172	43 948	58 452	71 264	95 312	5.2
B.C.	60 942	62 765	65 070	59 080	77 102	1.4
Yukon	439	455	505	558	617	2.0
N.W.T.	466	496	501	479	512	0.6
Canada	489 044	512 808	589 060	603 940	713 884	2.3

Source: Canadian electric utilities, and National Energy Board.

Figure 10.3. Comparison of electricity generation forecasts

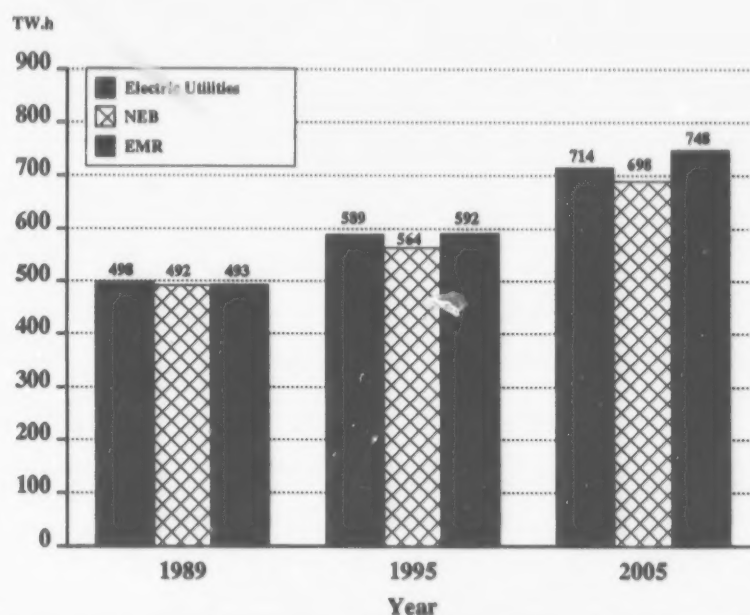


Table 10.6. Forecasts of electricity generation by fuel type in Canada

	1988	1990	1995	2000	2005
	(GW.h)				
Coal	86 192	78 622	88 177	117 359	146 677
Oil	10 982	12 705	9 397	6 779	9 446
Natural gas	8 045	8 653	14 216	11 091	23 556
Nuclear	78 176	87 975	114 579	110 352	114 579
Hydro	303 546	322 182	358 268	352 609	413 388
Other	2 103	2 671	4 423	5 750	6 238
Total	489 044	512 808	589 060	603 940	713 844

Source: Canadian electric utilities, and National Energy Board.

Table 10.7. Fuels required for electricity generation

	Coal (10 ³ tonnes)	Oil (m ³)	Natural Gas (10 ⁶ m ³)	Uranium (tonnes)
1988	47 270	2 491 752	3 628	1 358
1990	42 309	2 822 098	4 068	1 505
1995	48 924	1 888 962	5 874	1 956
2000	63 322	1 695 211	7 125	1 885
2005	77 116	1 867 864	8 473	1 955

Note: 1 m³ oil = 6.3 bbls
 1 m³ gas = 35.5 ft³
 1 tonne = 1000 kg

Source: Canadian electric utilities, and National Energy Board.

Table 10.8. Capital expenditures for major electric utilities, 1988-1998

	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
(millions of current dollars)											
Nfld.	136	132	172	175	196	94	222	348	524	644	656
P.E.I.	10	12	20	11	10	10	12	13	10	10	19
N.S.	102	217	326	331	357	256	259	302	335	406	204
N.B.	163	243	390	620	494	294	186	330	449	292	183
Quebec	2 107	2 486	3 103	3 455	4 031	5 064	5 778	5 115	5 672	6 826	6 112
Ontario	2 900	3 500	3 100	2 600	2 300	2 500	3 300	4 000	3 600	4 000	5 000
Man.	381	477	511	436	408	299	403	549	904	1 123	1 265
Sask.	200	236	375	390	281	353	429	328	303	239	424
Alta.	584	705	524	465	415	538	572	582	590	599	610
B.C.	260	304	323	382	334	531	635	809	1 147	1 653	1 627
Yukon	5	14	16	5	5	5	5	5	5	5	5
N.W.T.	27	14	24	36	24	12	9	9	9	9	9
Canada	6 875	8 391	8 884	8 906	8 855	9 956	11 810	12 390	13 548	15 806	16 113

* Actual data

Source: Canadian electric utilities.

Table 10.9. Capital expenditures by function, 1988-1998

	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
(millions of current dollars)											
Generation	3 299	4 226	4 526	4 460	4 409	5 120	6 002	6 682	7 549	8 265	8 257
Transmission	1 581	2 048	2 164	2 102	2 062	2 422	2 946	2 482	2 754	4 061	4 265
Distribution	1 251	1 225	1 326	1 397	1 509	1 555	1 663	1 768	1 736	1 812	1 887
Other	744	892	868	947	875	859	1 199	1 458	1 509	1 668	1 704
Total	6 875	8 391	8 884	8 906	8 855	9 956	11 810	12 390	13 548	15 806	16 113

* Actual data.

Source: Canadian electric utilities.

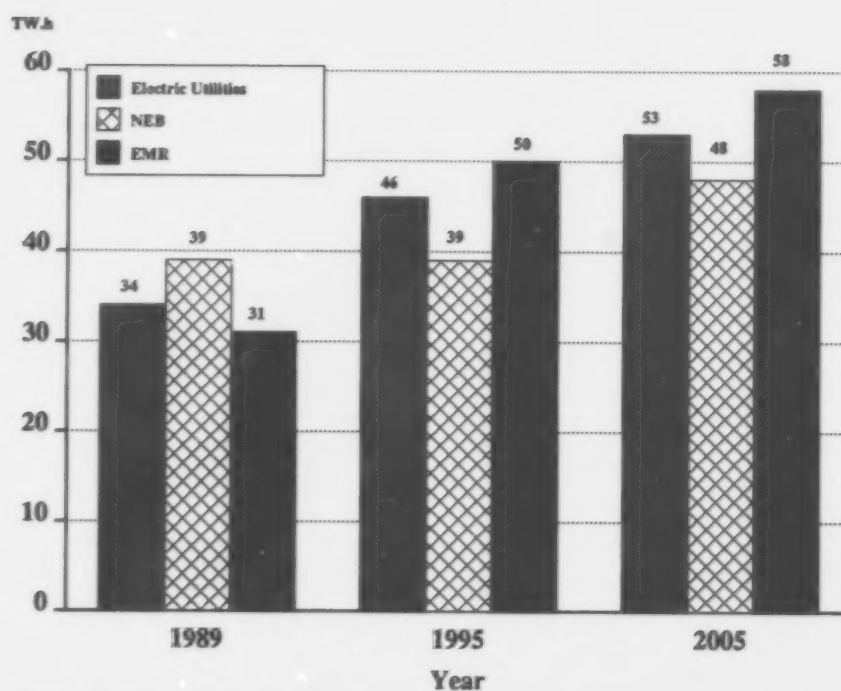
Table 10.10. Electricity exports to the United States

	1988*	1989	1990	1995	2000	2005
	(GW.h)					
New Brunswick	5 191	4 755	4 441	4 157	5 267	4 215
Quebec	11 863	12 267	11 822	16 059	23 341	26 289
Ontario	7 439	6 316	6 916	10 400	8 500	6 500
Manitoba	628	4 310	4 692	9 250	10 546	9 772
Saskatchewan	57	104	88	88	88	0
British Columbia	8 851	3 400	4 600	5 000	6 000	7 000
Canada	34 029	30 152	32 559	44 954	47 654	53 776

* Actual data.

Source : Canadian electric utilities.

Figure 10.4. Comparison of electricity export forecasts



APPENDIX A

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Table A1. Installed capacity and electrical energy consumption in Canada, 1920-1988

Year	Installed Capacity					Electrical Energy Consumption	Average Demand	Peak Demand	Reserve Margin		Load Factor
	Thermal			Hydro	Total						
	Conventional	Nuclear	Sub-Total								
	(MW)					(GW.h)	(MW)	(MW)	(MW)	(%)	(%)
						(a)	(b)	(c)	(d)		(e)
1920	300	-	300	1 700	2 000	-	-	-	-	-	-
1930	400	-	400	4 300	4 700	19 468	2 222	-	-	-	-
1940	500	-	500	6 200	6 700	33 062	3 774	-	-	-	-
1950	900	-	900	8 900	9 800	55 037	6 283	-	-	-	-
1955	2 100	-	2 100	12 600	14 700	81 000	9 247	12 536	2 164	17	74
1960r	4 392	-	4 392	18 643	23 035	109 304	12 478	17 264	5 771	33	72
1965	7 557	20	7577	21 771	29 348	144 165	16 457	24 167	5 181	21	68
1970	14 287	240	14 527	28 298	42 826	202 337	23 098	34 592	8 234	24	67
1975	21 404	2 666	24 070	37 282	61 352	265 955	30 360	46 187	15 165	33	66
1976	23 039	3 466	26 505	39 488	65 993	284 829	32 515	49 527	16 456	33	66
1977	24 699	5 066	29 765	40 810	70 575	299 673	34 209	52 001	18 574	36	66
1978	26 154	5 866	32 020	41 898	73 918	316 435	36 123	54 106	19 812	37	67
1979	27 353	5 866	33 219	44 009	77 228	323 465	36 925	55 699	21 529	39	66
1980r	28 363	5 866	34 229	47 770	81 999	340 068	38 821	59 170	22 829	39	66
1981	28 493	5 600	34 093	49 216	83 308	346 333	39 536	59 237	24 071	41	67
1982	28 957	6 547	35 504	50 007	85 511	345 115	39 397	62 417	23 094	37	63
1983	30 447	7 771	38 218	51 274	89 492	359 838	41 077	66 866	22 626	34	61
1984	30 427	9 813	40 240	54 949	95 189	385 516	44 009	65 798	29 391	45	67
1985r	30 476	10 664	41 140	57 731	98 871	406 859	46 445	71 235	27 636	39	65
1986r	30 980	11 098	42 078	57 731	99 809	421 817	48 153	70 364	29 445	42	68
1987r	30 80	12 528	43 328	57 945	101 273	438 152	50 017	77 923	23 350	30	64
1988p	30 914	12 586	43 500	57 484	100 984	461 320	52 662	78 382	22 602	29	67

(a) 1920-55: Figures are approximate, computed using actual Statistics Canada data for stations generating energy from sale to which have been added estimates for stations generating entirely for own use. 1920-55: Canadian Energy Prospects (Royal Commission on Canada's Economic Prospects) John Davis, 1957. 1956-81: Statistics Canada Publication. 57-202.

(b) Average Demand = Energy Consumption ÷ 8 760 (hrs/yr).

(c) Statistics Canada Publication 57-204.

(d) Reserve margin = $\frac{\text{Installed capacity} - \text{Peak demand}}{\text{Peak demand}}$

(e) Load Factor = $\frac{\text{Average demand}}{\text{Peak demand}}$

p Preliminary figures. r Revised figures.

Source: Statistics Canada. Energy, Mines and Resources Canada.

Table A2. Installed and proposed generating capacity, 1988

	Hydro	Nuclear	Conventional Thermal	Total	% of Canadian Total
	(MW)				
Newfoundland	6 644	0	782	7 426	7.35
Prince Edward Island	0	0	122	122	.12
Nova Scotia	386	0	1 959	2 345	2.32
New Brunswick	903	680	1 908	3 491	3.46
Quebec	25 585	685	988	27 258	26.99
Ontario	7 775	11 221	13 959	32 955	32.63
Manitoba	3 641	0	484	4 125	4.08
Saskatchewan	832	0	2 013	2 845	2.82
Alberta	734	0	6 866	7 600	7.53
British Columbia	10 848	0	1 649	12 497	12.38
Yukon	83	0	41	124	.12
Northwest Territories	53	0	143	196	.19
Canada (Totals as of December 31, 1988)	57 484	12 586	30 914	100 984	100.00
Percentage of total	56.92	12.46	30.61	100.00	
Net additions during 1988	-461	58	114	-289	
Planned additions, 1989	1 056	881	485	2 422	

Source: Energy, Mines and Resources Canada.

Table A3. Conventional thermal capacity by principal fuel type* (MW)

	Steam				Gas Turbine			Internal Combustion			All Conventional Thermal				
	Coal	Oil	Gas	Other	Total	Oil	Gas	Total	Oil	Gas	Total	Coal	Oil	Gas	Other** Total
Nfld.	0	530	0	0	530	170	0	170	82	0	82	0	782	0	0 782
P.E.I.	0	70	0	0	70	41	0	41	11	0	11	0	122	0	0 122
N.S.	1 182	553	0	19	1 754	205	0	205	1	0	1	1 182	759	0	19 1 960
N.B.	318	1 492	0	58	1 868	23	0	23	16	0	16	318	1 531	0	58 1 907
Que.	0	615	8	5	628	260	0	260	100	0	100	0	975	8	5 988
Ont.	10 872	2 200	186	63	13 321	447	181	628	4	6	10	10 872	2 651	373	63 13 959
Man.	419	0	4	23	446	24	0	24	14	0	14	419	38	4	23 484
Sask.	1 531	21	277	22	1 851	0	155	155	6	0	6	1 531	27	432	22 2 012
Alta.	4 861	0	1 318	118	6 297	0	524	524	15	30	45	4 861	15	1 872	118 6 866
B.C.	0	68	1 005	330	1 403	100	51	151	79	17	96	0	247	1 073	330 1 650
Yukon	0	0	0	0	0	0	20	20	44	0	44	0	44	20	0 64
N.W.T.	0	0	0	0	0	0	0	0	121	0	121	0	121	0	0 121
Canada	19 183	5 549	2 798	638	28 168	1 270	931	2 201	493	53	546	19 183	7 312	3 782	638 30 915

* Preliminary figures as of December 31, 1988.

** Mainly wood wastes and black liquor.

Numbers may not total due to rounding.

Source: Electrical Energy Branch, Energy, Mines and Resources Canada.

Table A4. Electrical energy production by principal fuel type, 1988

	Conventional Thermal*				Nuclear	Hydro	Total	% of Total Generation	% Generated By	
	Coal	Oil	Gas	Total					Utilities	Industry
(GW.h)										
Newfoundland	0	1 419	0	1 419	0	39 731	41 150	8.41	98.75	1.25
Prince Edward Island	0	85	0	85	0	0	85	.02	100.00	.00
Nova Scotia	6 033	1 752	0	7 785	0	1 107	8 892	1.82	95.93	4.07
New Brunswick	1 865	6 188	0	7 983	5 342	2 580	15 905	3.25	95.32	4.68
Quebec	0	332	0	332	5 282	143 391	149 005	30.47	88.56	11.44
Ontario	35 033	510	1 334	36 877	67 552	38 314	142 743	29.19	97.21	2.79
Manitoba	924	0	5	929	0	15 379	16 308	3.33	99.72	.28
Saskatchewan	9 853	19	722	10 594	0	2 343	12 937	2.65	97.53	2.47
Alberta	33 627	120	4 994	38 741	0	1 431	40 172	8.21	91.95	8.05
British Columbia	0	420	1 949	2 369	0	58 573	60 942	12.46	80.60	19.40
Yukon	0	30	0	30	0	409	439	.09	100.00	.00
N.W.T.	0	177	1	178	0	288	466	.10	94.21	5.79
Canada	87 335	10 982	9 005	107 322	78 176	303 546	489 044	100.00	94.98	5.02

* The conventional thermal breakdown is estimated.

Source: Statistics Canada. Energy, Mines and Resources Canada.

Table A5. Provincial electricity imports and exports (GW.h)

Province	Year	Interprovincial Trade			International Trade*			Total Net Exports
		Exports	Imports	Net Exports	Exports	Imports	Net Exports	
Newfoundland	1988	30 727	-	30 727	-	-	-	30 727
	1987	30 393	-	30 393	-	-	-	30 393
	1986	30 695	-	30 695	-	-	-	30 695
	1985	31 837	-	31 837	-	-	-	31 837
	1984	36 043	-	36 043	-	-	-	36 043
Prince Edward Island	1988	-	486	-486	-	-	-	-486
	1987	-	483	-483	-	-	-	-483
	1986	-	610	-610	-	-	-	-610
	1985	-	575	-575	-	-	-	-575
	1984	-	539	-539	-	-	-	-539
Nova Scotia	1988	166	186	-20	-	-	-	-20
	1987	82	659	-577	-	-	-	-577
	1986	71	611	-540	-	-	-	-540
	1985	199	350	-151	-	-	-	-151
	1984	282	301	-19	-	-	-	-19
New Brunswick	1988	981	2 856	-1 875	5 191	190	5 001	3 126
	1987	1 164	6 922	-5 758	6 141	266	5 875	117
	1986	1 230	7 275	-6 045	7 008	424	6 584	539
	1985	927	6 026	-5 099	6 093	12	6 081	982
	1984	841	4 588	-3 747	5 657	17	5 640	1 893
Quebec	1988	4 979	31 079	-26 100	11 863	86	11 777	-14 323
	1987	12 782	30 427	-17 645	16 401	-	16 401	-1 244
	1986	14 496	30 712	-16 216	12 674	35	12 639	-3 577
	1985	14 491	31 878	-17 387	9 581	3	9 578	-7 809
	1984	11 668	36 105	-24 437	11 250	8	11 242	-13 195
Ontario	1988	65	2 827	-2 762	7 439	2 611	4 828	.066
	1987	16	6 992	-6 976	8 497	2 113	6 384	-592
	1986	22	8 027	-8 005	7 957	1 693	6 264	-1 441
	1985	44	9 632	-9 588	10 563	1 701	8 862	-726
	1984	64	8 302	-8 238	11 370	913	10 457	2 219
Manitoba	1988	1 908	1 126	782	628	1 969	-1 341	-559
	1987	2 311	1 220	1 091	3 461	512	2 949	4 040
	1986	1 946	1 087	859	6 989	12	6 977	7 836
	1985	2 524	1 238	1 286	5 660	45	5 615	6 901
	1984	2 565	1 301	1 264	5 057	43	5 014	6 278
Saskatchewan	1988	1 109	1 369	-260	57	315	-258	-518
	1987	1 222	1 262	-40	113	84	29	-11
	1986	1 076	1 210	-134	151	64	87	-47
	1985	1 236	1 556	-320	163	93	70	-250
	1984	1 302	1 625	-323	86	66	20	-303

Table A5. Provincial electricity imports and exports (GW.h) (continued)

Province	Year	Interprovincial Trade			International Trade*			Total Net Exports
		Exports	Imports	Net Exports	Exports	Imports	Net Exports	
Alberta	1988	1 218	369	849	-	-	-	849
	1987	710	526	184	-	2	-2	182
	1986	617	555	62	-	3	-3	59
	1985	243	278	-35	-	2	-2	-37
	1984	262	302	-40	-	2	-2	-42
British Columbia	1988	364	1 219	-855	8 851	1 132	7 719	6 864
	1987	521	710	-189	12 815	493	12 322	12 133
	1986	553	617	-64	4 156	2 727	1 429	1 365
	1985	275	243	32	10 956	837	10 119	10 151
	1984	298	262	36	8 015	1 294	6 721	6 757
Yukon	1988	-	-	-	-	-	-	-
	1987	-	-	-	-	-	-	-
	1986	-	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-
	1984	-	-	-	-	-	-	-
Northwest Territories	1988	-	-	-	-	-	-	-
	1987	-	-	-	-	-	-	-
	1986	-	-	-	-	-	-	-
	1985	-	-	-	-	-	-	-
	1984	-	-	-	-	-	-	-
Canada	1988	-	-	-	34 029	6 305	27 724	27 724
	1987	-	-	-	47 428	3 470	43 958	43 958
	1986	-	-	-	38 934	4 957	33 977	33 977
	1985	-	-	-	43 016	2 693	40 323	40 323
	1984	-	-	-	41 436	2 343	39 093	39 093

* Includes exchanges.

Source: Statistics Canada.

Table A6. Canadian electricity exports by exporter and importer, 1988*

Exporter	Importer	Revenue (\$000)	Quantity (GW.h)
Fraser Inc.	Fraser Paper Ltd. (Maine)	19 477	380
Maine & New Brunswick Electrical Power Co. Ltd.	Maine Public Service Co. (Maine)	1 849	84
NB Power	Maine Public Service Co. (Maine)	6 085	175
NB Power	Eastern Maine Electric Cooperative Inc. (Maine)	3 815	68
NB Power	Maine Electric Power (Maine)	33 415	991
NB Power	Central Maine Power Co. (Maine)	38 375	1 163
NB Power	Bangor Hydro-Electric Co. (Maine)	7 128	229
NB Power	Massachusetts Municipal Wholesale Electric Co. (Massachusetts)	45 216	842
NB Power	Boston Edison Co. (Massachusetts)	50 778	863
NB Power	Commonwealth Electric Co. (Massachusetts)	12 419	210
NB Power	Public Service Co. of N.H. (New Hampshire)	4 030	43
NB Power	New England Elec. Power Co. (New England)	632	4
Hydro-Québec	Boston Edison Co. (Massachusetts)	9 167	214
Hydro-Québec	Montaup Electric Co. (Massachusetts)	2 765	64
Hydro-Québec	Citizens Utilities Co. (Vermont)	6 956	181
Hydro-Québec	Vermont Joint Owners (Vermont)	10 949	448
Hydro-Québec	Vermont Dep't of Public Service (Vermont)	47 434	1 157
Hydro-Québec	Vermont Marble Company (Vermont)	142	3
Hydro-Québec	New England Power Pool (New England)	11 407	3 931
Hydro-Québec	Niagara Mohawk Power Corp. (New York)	38 562	1 339
Hydro-Québec	New York Power Authority (New York)	118 249	4 525
Cornwall Electric	Niagara Mohawk Power Corp. (New York)	6 608	246
Canadian Niagara	Niagara Mohawk Power Corp. (New York)	10 984	396
Ontario Hydro	Vermont Dep't of Public Service (Vermont)	14 681	401
Ontario Hydro	Niagara Mohawk Power Corp. (New York)	116 734	3 853
Ontario Hydro	New York Power Authority (New York)	991	35
Ontario Hydro	New York Power Pool (New York)	10 203	304
Ontario Hydro	Detroit Edison Co. (Michigan)	10 248	382
Ontario Hydro	Minnesota Power & Light Co. (Minnesota)	170	4
Boise Cascade Canada Ltd.	Boise Cascade (Minnesota)	3	N
Manitoba Hydro	Northern States Power Co. (Minnesota)	17 309	605
Manitoba Hydro	Otter Tail Power Co. (Minnesota)	663	27
Manitoba Hydro	United Power Association (Minnesota)	40	1
Manitoba Hydro	Minnesota Power & Light Co. (Minnesota)	440	24
Manitoba Hydro	Minnkota Power Cooperative Inc. (North Dakota)	1 619	64
Saskatchewan Power Corporation	Basin Electric Power Cooperative (North Dakota)	27	1

Table A6. Canadian electricity exports by exporter and importer, 1988* (continued)

Exporter	Importer	Revenue (\$000)	Quantity (GW.h)
Cominco Ltd.	Bonneville Power Administration (Washington)	787	36
Cominco Ltd.	Puget Sound Power & Light Co. (Washington)	1 342	68
Cominco Ltd.	Washington Water Power Co. (Washington)	339	19
Cominco Ltd.	Portland General Electric Co. (Oregon)	4 820	261
Cominco Ltd.	Pacific Power & Light Co. (Oregon)	62	4
Cominco Ltd.	Idaho Power Co. (Idaho)	841	46
Cominco Ltd.	Montana Power Co. (Montana)	37	2
Cominco Ltd.	Bonneville Power Administration (California)	1 436	69
Cominco Ltd.	Sierra Pacific Power Co. (Nevada)	384	20
Cominco Ltd.	Utah Power & Light Co. (Utah)	6	N
B.C. Hydro	Bonneville Power Administration (Washington)	10 481	467
B.C. Hydro	Puget Sound Power & Light Co. (Washington)	6 298	282
B.C. Hydro	Washington Water Power Co. (Washington)	4 454	162
B.C. Hydro	Seattle City Light (Washington)	771	32
B.C. Hydro	Portland General Electric Co. (Oregon)	37 230	2 717
B.C. Hydro	Pacific Power & Light Co. (Oregon)	293	15
B.C. Hydro	Idaho Power Co. (Idaho)	630	28
B.C. Hydro	Montana Power Co. (Montana)	79	3
B.C. Hydro	Bonneville Power Administration (California)	49 817	2 200
B.C. Hydro	Sierra Pacific Power Co. (Nevada)	452	21
B.C. Hydro	Utah Power & Light Co. (Utah)	185	8

N = negligible

* Excludes border accommodations.

Source: Energy, Mines and Resources Canada.

Table A7. Generation capacity by type (MW)

	Steam	Gas Turbine	Internal Combustion	Nuclear	Total Thermal	Hydro	Total
NEWFOUNDLAND							
Total end 1987	504.60	170.39	82.21	-	757.20	6 643.80	7 401.00
Changes 1988	25.00	-	-	-	25.00	-	25.00
Total end 1988	529.60	170.39	82.21	-	782.20	6 643.80	7 426.00
Additions proposed							
1989	25.00	-	-	-	25.00	-	25.00
1990	-	-	-	-	.00	-	.00
1991	-	108.00	-	-	108.00	-	108.00
1992	-	-	-	-	.00	31.00	31.00
2005	-	54.00	-	-	54.00	-	54.00
2007	-	54.00	-	-	54.00	-	54.00
2008	-	54.00	-	-	54.00	-	54.00
2010	-	54.00	-	-	54.00	-	54.00
Total end 2010	554.60	494.39	82.21	-	1 131.20	6 674.80	7 806.00
PRINCE EDWARD ISLAND							
Total end 1987	70.50	40.85	11.14	-	122.49	-	122.49
Changes 1988	-	-	-	-	.00	-	.00
Total end 1988	70.50	40.85	11.14	-	122.49	-	122.49
NOVA SCOTIA							
Total end 1987	1 753.79	205.00	0.60	-	1 959.39	386.36	2 345.75
Changes 1988	-	-	-	-	.00	-	.00
Total end 1988	1 753.79	205.00	0.60	-	1 959.39	386.36	2 345.75
Additions proposed							
1991	150.00	-	-	-	150.00	-	150.00
1993	150.00	-	-	-	150.00	-	150.00
1995	150.00	-	-	-	150.00	-	150.00
1997	150.00	-	-	-	150.00	-	150.00
1998	150.00	-	-	-	150.00	-	150.00
2000	150.00	-	-	-	150.00	-	150.00
Total end 2000	2 653.79	205.00	0.60	-	2 859.39	386.36	3 245.75

Table A7. Generation capacity by type (MW) (continued)

	Steam	Gas Turbine	Internal Combustion	Nuclear	Total Thermal	Hydro	Total
NEW BRUNSWICK							
Total end 1987	1 868.08	23.38	16.34	680.00	2 587.80	903.03	3 490.83
Changes 1988	-	-	-	-	.00	-	.00
Total end 1988	1 868.08	23.38	16.34	680.00	2 587.80	903.03	3 490.83
Additions proposed							
1989	25.00	30.00	-	-	55.00	-	55.00
1993	450.00	-	-	-	450.00	-	450.00
1994	200.00	-	-	-	200.00	-	200.00
1998	450.00	-	-	-	450.00	-	450.00
Total end 1998	2 993.08	53.38	16.34	680.00	3 742.80	903.03	4 645.83
QUEBEC							
Total end 1987	627.65	362.88	100.18	685.00	1 775.71	26 050.80	27 826.51
Changes 1988	-	-103.00	-	-	-103.00	-466.00	-569.00
Total end 1988	627.65	259.88	100.18	685.00	1 672.71	25 584.80	27 257.51
Additions proposed							
1989	-	-	-	-	.00	1 056.00	1 056.00
1990	-	-	-	-	.00	-	.00
1991	-	-	-	-	.00	950.00	950.00
1992	-	124.00	-	-	124.00	950.00	1 074.00
1993	-	372.00	-	-	372.00	-	372.00
1994	-	-	-	-	.00	700.00	700.00
1995	-	-	-	-	.00	1 517.00	1 517.00
1996	-	-	-	-	.00	699.00	699.00
1997	-	-	-	-	.00	614.00	614.00
1998	-	-	-	-	.00	2 009.00	2 009.00
1999	-	-	-	-	.00	1 244.00	1 244.00
2000	-	-	-	-	.00	680.00	680.00
2001	-	-	-	-	.00	330.00	330.00
2002	-	-	-	-	.00	110.00	110.00
2003	-	-	-	-	.00	424.00	424.00
2004	-	-	-	-	.00	775.00	775.00
2005	-	-	-	-	.00	249.00	249.00
2006	-	-	-	-	.00	621.00	621.00
Total end 2006	627.65	755.88	100.18	685.00	2 168.71	38 512.80	40 681.51

Table A7. Generation capacity by type (MW) (continued)

	Steam	Gas Turbine	Internal Combustion	Nuclear	Total Thermal	Hydro	Total
ONTARIO							
Total end 1987	13 183.15	575.93	9.52	11 163.00	24 931.60	7 770.80	32 702.40
Changes 1988	138.00	52.00	-	58.00	248.00	4.00	252.00
Total end 1988	13 321.15	627.93	9.52	11 221.00	25 179.60	7 774.80	32 954.40
Additions proposed							
1989	-	-	-	881.00	881.00	-	881.00
1990	-	-	-	-	.00	-	.00
1991	-	-	-	1 762.00	1 762.00	-	1 762.00
1992	-	-	-	881.00	881.00	-	881.00
Total end 1992	13 321.15	627.93	9.52	14 745.00	28 703.60	7 774.80	36 478.40
MANITOBA							
Total end 1987	445.80	23.80	14.16	-	483.76	3 641.10	4 124.86
Changes 1988	-	-	-	-	.00	-	.00
Total end 1988	445.80	23.80	14.16	-	483.76	3 641.10	4 124.86
Additions proposed							
1990	-	-	-	-	.00	256.00	256.00
1991	-	-	-	-	.00	640.00	640.00
1992	-	-	-	-	.00	384.00	384.00
1999	-	-	-	-	.00	260.00	260.00
2000	-	-	-	-	.00	390.00	390.00
2001	-	-	-	-	.00	650.00	650.00
2002	-	-	-	-	.00	87.50	87.50
2012	-	-	-	-	.00	262.50	262.50
2013	-	-	-	-	.00	262.50	262.50
Total end 2013	445.80	23.80	14.16	-	483.76	6 571.10	7 054.86
SASKATCHEWAN							
Total end 1987	1 851.76	154.92	6.60	-	2 013.28	832.56	2 845.84
Changes 1988	-	-	-	-	.00	-	.00
Total end 1988	1 851.76	154.92	6.60	-	2 013.28	832.56	2 845.84
Additions proposed							
1991	-	50.00	-	-	50.00	-	50.00
1992	300.00	-	-	-	300.00	-	300.00
1993	-	50.00	-	-	50.00	-	50.00
1994	-	-	-	-	.00	100.00	100.00
1995	-	50.00	-	-	50.00	-	50.00
Total end 1995	2 151.76	304.92	6.60	-	2 463.28	932.56	3 395.84

Table A7. Generation capacity by type (MW) (continued)

	Steam	Gas Turbine	Internal Combustion	Nuclear	Total Thermal	Hydro	Total
ALBERTA							
Total end 1987	6 297.42	524.10	44.87	-	6 866.39	733.70	7 600.09
Changes 1988	-	-	-	-	.00	-	.00
Total end 1988	6 297.42	524.10	44.87	-	6 866.39	733.70	7 600.09
Additions proposed							
1989	400.00	-	-	-	400.00	-	400.00
1990	380.00	-	-	-	380.00	-	380.00
1991	400.00	-	-	-	400.00	-	400.00
1994	-	400.00	-	-	400.00	-	400.00
1995	383.00	-	-	-	383.00	-	383.00
1996	383.00	-	-	-	383.00	-	383.00
1997	-	700.00	-	-	700.00	-	3 700.00
1998	360.00	100.00	-	-	460.00	-	460.00
1999	360.00	300.00	-	-	660.00	-	660.00
Total end 1999	8 963.42	2 024.10	44.87	-	11 032.39	733.70	11 766.09
BRITISH COLUMBIA							
Total end 1987	1 402.16	150.70	95.78	-	1 648.64	10 847.87	12 496.51
Changes 1988	-	-	-	-	.00	-	.00
Total end 1988	1 402.16	150.70	95.78	-	1 648.64	10 847.87	12 496.51
Additions proposed							
2000	-	-	-	-	.00	300.00	300.00
2001	-	-	-	-	.00	760.00	760.00
2002	-	-	-	-	.00	80.00	80.00
2003	-	-	-	-	.00	-	.00
2004	-	-	-	-	.00	110.00	110.00
2005	500.00	-	-	-	500.00	110.00	610.00
2006	500.00	-	-	-	500.00	55.00	555.00
2007	500.00	-	-	-	500.00	-	500.00
2008	500.00	-	-	-	500.00	-	500.00
Total end 2008	3 402.16	150.70	95.78	-	3 648.64	12 262.87	15 911.51
YUKON and N.W.T.							
Total end 1987	.00	19.50	162.24	-	181.74	135.10	316.84
Changes 1988	-	-	2.50	-	2.50	1.00	3.50
Total end 1988	.00	19.50	164.74	-	184.24	136.10	320.34

Table A7. Generation capacity by type (MW) (continued)

	Steam	Gas Turbine	Internal Combustion	Nuclear	Total Thermal	Hydro	Total
Additions proposed							
1989	-	-	4.60	-	4.60	-	4.60
1990	-	-	-	-	.00	.80	.80
1991	-	-	1.40	-	1.40	-	1.40
1992	-	-	.60	-	.60	-	.60
1993	-	-	5.20	-	5.20	-	5.20
1994	-	-	1.30	-	1.30	-	1.30
Total end 1994	.00	19.50	177.84	-	197.34	136.90	334.24
CANADA							
Total end 1987	28 004.91	2 251.45	543.64	12 528.00	43 328.00	57 945.12	101 273.12
Changes 1988	163.00	-51.00	2.50	58.00	172.50	-461.00	-288.50
Total end 1988	28 167.91	2 200.45	546.14	12 586.00	43 500.50	57 484.12	100 984.62
Additions proposed							
1989	450.00	30.00	4.60	881.00	1 365.60	1 056.00	2 421.60
1990	380.00	-	-	-	380.00	256.00	636.80
1991	550.00	158.00	1.40	1 762.00	2 471.40	1 590.00	4 061.40
1992	300.00	124.00	.60	881.00	1 305.60	1 365.00	2 670.60
1993	600.00	422.00	5.20	-	1 027.20	-	1 027.20
1994	200.00	400.00	1.30	-	601.30	800.00	1 401.30
1995	533.00	50.00	-	-	583.00	1 517.00	2 100.00
1996	383.00	-	-	-	383.00	699.00	1 082.00
1997	150.00	700.00	-	-	850.00	614.00	1 464.00
1998	960.00	100.00	-	-	1 060.00	2 009.00	3 069.00
1999	360.00	300.00	-	-	660.00	1 504.00	2 164.00
2000	150.00	-	-	-	150.00	1 370.00	1 520.00
2001	-	-	-	-	.00	1 740.00	1 740.00
2002	-	-	-	-	.00	190.00	190.00
2003	-	-	-	-	.00	424.00	424.00
2004	-	-	-	-	.00	885.00	885.00
2005	500.00	54.00	-	-	554.00	359.00	913.00
2006	500.00	-	-	-	500.00	676.00	1 176.00
2007	500.00	54.00	-	-	554.00	-	554.00
2008	500.00	54.00	-	-	554.00	-	554.00
2010	-	54.00	-	-	54.00	-	54.00
2012	-	-	-	-	.00	87.50	87.50
2013	-	-	-	-	.00	262.50	262.50
Total end 2013	35 183.91	4 700.45	559.24	16 110.00	56 553.60	74 888.92	131 442.52

Source: Energy, Mines and Resources Canada.

**Table A8. Installed generating capacity expansion in Canada by station.
Major 1988 additions and 1989 - 2013 projections**

Province and Station	Type*	1988 Additions	Completion Date	Additions Proposed	Status*	Plant Capacity
		(MW)		(MW)		(MW)
NEWFOUNDLAND						
Holyrood ¹	S(o)	25	1988		I	
			1989	25	P	500
Stephenville	GT(o)		1991	54	P	108
Hardwoods	GT(o)		1991	54	P	108
Undecided	H		1992	31	P	31
Undecided	GT(o)		2005	54	P	
			2007	54	P	
			2008	54	P	
			2010	54	P	216
NOVA SCOTIA						
Point Aconi	S(c)		1993	150	P	
			1995	150	P	
			1997	150	P	450
New Site	S(c)		1998	150	P	
			2000	150	P	300
Trenton	S(c)		1991	150	C	360
NEW BRUNSWICK						
Belledune	S(c)		1993	450	P	
			1998	450	P	900
Grand Lake	S(c)		1994	200	P	285
Grand Manan	GT(o)		1989	30	C	30
Coleson Cove ¹	S(o)		1989	25	C	1 075
QUEBEC						
La Forge-1	H		1995	5 x 136	P	
			1995	137	P	817
La Forge-2	H		1996	3 x 90	P	270
Manic-1 ¹	H		2003	134	P	318
Manic-2 ¹	H		2003	290	P	1 305
Manic-3 ¹	H		1997	2 x 285	P	1 753
Manic-5 ¹	H		1994	44	P	1 468
			1995	44	P	
			1996	44	P	
			1997	44	P	
LG-1	H		1994	4 x 109	P	
			1994	2 x 110	P	

¹ Upgrading of existing units.

**Table A8. Installed generating capacity expansion in Canada by station.
Major 1988 additions and 1989 - 2013 projections (continued)**

Province and Station	Type*	1988 Additions	Completion Date	Additions Proposed	Status*	Plant Capacity
		(MW)		(MW)		(MW)
QUEBEC (continued)						
LG-2A	H		1995	4 x 109	P	1 312
			1995	2 x 110	P	
			1991	2 x 317	P	
			1991	316	P	
			1992	2 x 317	P	
Ste-Marguerite-3	H		1992	316	P	7 228
			1998	2 x 411	P	
			1998	2 x 396	P	
			1998	395	P	
			1999	396	P	
Grande Baleine-1	H		1999	395	P	1 978
			2000	154	P	
			2000	2 x 153	P	
			1999	3 x 151	P	
			2001	3 x 110	P	
Grande Baleine-2	H		2000	2 x 110	P	330
Grande Baleine-3	H		2002	110	P	330
Ashuapmushuan-3	H		2004	3 x 170	P	510
Ashuapmushuan-4	H		2004	5 x 53	P	265
Eastmain-1	H		1992	124	P	
Quenonisca	H		1993	372	P	496
Future peaking	GT(d)					
ONTARIO						
Darlington	N		1989	881	C	3 628
			1991	2 x 881	C	
			1992	881	C	
			1989		I	
	GT	52				
MANITOBA						
Limestone	H		1990	2 x 128	C	1 280
			1991	5 x 128	C	
			1992	3 x 128	C	
Conawapa	H		1999	2 x 130	P	1 300
			2000	3 x 130	P	
			2001	5 x 130	P	
Wuskwatim	H		2012	87.5	P	350
			2013	3 x 87.5	P	

**Table A8. Installed generating capacity expansion in Canada by station.
Major 1988 additions and 1989 - 2013 projections (continued)**

Province and Station	Type*	1988 Additions	Completion Date	Additions Proposed	Status*	Plant Capacity
		(MW)		(MW)		(MW)
SASKATCHEWAN						
Shand	S(c)		1992	300	C	300
Future peaking 1	GT(g)		1991	50	P	50
Future peaking 2	GT(g)		1993	50	P	50
Future peaking 3	GT(g)		1995	50	P	50
Future Hydro	H		1994	100	P	100
ALBERTA						
Genesee	S(c)		1989	400	C	
			1991	400	C	800
Sheerness	S(c)		1990	380	C	760
New Steam	S(c)		1995	383	P	
			1996	383	P	
			1998	360	P	
			1999	360	P	1 486
Peak Gas	GT		1994	4 x 100	P	
			1997	7 x 100	P	
			1998	100	P	
			1999	3 x 100	P	1 500
BRITISH COLUMBIA						
Keenleyside	H		2001	2 x 80	P	
			2002	80	P	240
Peace Site C	H		2000	2 x 150	P	
			2001	4 x 150	P	900
Murphy Creek	H		2004	2 x 55	P	
	H		2005	2 x 55	P	
			2006	55	P	275
Hat Creek	S(c)		2005	500	P	
			2006	500	P	
			2007	500	P	
			2008	500	P	2 000

**Table A8. Installed generating capacity expansion in Canada by station.
Major 1988 additions and 1989 - 2013 projections (continued)**

Province and Station	Type*	1988 Additions	Completion Date	Additions Proposed	Status*	Plant Capacity
		(MW)		(MW)		(MW)
YUKON						
Dawson	IC		1993	1	P	4.4
McIntyre	H		1990	0.8	P	1.5
NORTHWEST TERRITORIES						
Various	IC	2.5	1989	4.6	P	
			1991	1.4	P	
			1992	0.6	P	
			1993	4.2	P	
			1994	1.3	P	

* Legend

H Hydro
S(c) Steam (coal)
N Nuclear
P Planned
GT(o) Gas turbine (oil)
GT(g) Gas turbine (natural gas)
GT(d) Gas turbine (diesel)

IC Internal combustion
GT Gas turbine
I Installed
C Under construction

Source: Energy, Mines and Resources Canada.

APPENDIX B

B1. Chronology of Canadian Electrical Energy Developments and Achievements	91
B2. Chronology of Regional Interconnections	95

B1. Chronology of Canadian Electrical Energy Developments and Achievements

- | | | | |
|------|--|------|--|
| 1846 | Toronto, Hamilton, Niagara, and St. Catharines Electro-Magnetic Telegraph Company formed. | 1883 | Canada's first electric lighting plant started at Canadian Cottons, Cornwall, Ontario, by Thomas Edison. |
| 1847 | Montreal Telegraph Company formed with lines from Quebec City to Toronto. | 1883 | Toronto's first electric railway built by J.J. Wright. |
| 1858 | Message sent from Queen Victoria to U.S. President Buchanan via first trans-Atlantic cable from Valentia, Ireland, to White Sands Bay, Newfoundland. | 1883 | Canada's first street lights installed in Hamilton, Ontario. |
| 1873 | Davis House in Winnipeg used arc light to illuminate front of building. | 1884 | Canada's first electric utility set up in Pembroke, Ontario, by R.B. McAllister. |
| 1876 | Alexander Graham Bell made first long-distance telephone call from Paris, Ontario, to Brantford, Ontario, via battery power in Toronto - a total distance of 218 km. | 1884 | Electric street lighting installed in Montreal and Toronto. |
| 1878 | Robert McMicking began experiments with electric street lighting in Victoria. | 1885 | First Canadian electric streetcar enters service in Toronto. |
| 1878 | American Electric and Illuminating Company formed in Montreal—Canada's first electric light company. | 1885 | St. John's Electric Light Company produced power for street and shop lighting. |
| 1879 | British Columbia Electric Railway launched. | 1886 | Victoria Electric Lighting Company (forerunner of B.C. Electric and B.C. Hydro) formed. |
| 1879 | Electric light demonstrated in McConkey's Restaurant, Toronto. | 1887 | Hydroelectric plant built at Twelve Mile Creek, near Welland, Ontario. |
| 1881 | Toronto's first electric generator built by J.J. White. T. Eaton was the first customer. | 1887 | Canadian engineer Sir Sandford Fleming completed Pacific cable. |
| 1881 | Ahearn & Soper of Ottawa introduced electric light for industry. | 1889 | Calgary sawmill run by electricity; electric lights in Calgary, Brandon, and Winnipeg. |
| 1882 | One of North America's first hydroelectric generating facilities constructed at Chaudière Falls on the Ottawa River. | 1890 | Electric lights in Regina, Kenora, Portage la Prairie, and Moosejaw. |
| 1882 | F. Nicholls formed Toronto Electric Supply Company (forerunner of Canadian General Electric). | 1891 | Canadian Electrical Association formed. |
| | | 1891 | Edmonton Electric Light & Power Company begins operations. |
| | | 1892 | Canadian General Electric incorporated. |
| | | 1892 | Montreal's first hydroelectric plant established on the Lachine Canal. |
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| 1892 | Canadian Niagara Power Company incorporated. | 1904 | First significant exchange of power with the United States initiated at Niagara Falls. |
| 1892 | Thomas L. "Carbide" Willson of Woodstock, Ontario, developed the electric-furnace process to manufacture calcium carbide. | 1905 | Ontario Hydro established. |
| 1896 | Marconi applied for a patent on wireless telegraphy. | 1906 | Hydroelectric power transmitted 96 km from the Winnipeg River to Winnipeg. |
| 1897 | Hydroelectric power from Montmorency Falls supplies street lighting in Quebec City. | 1910 | Canada's installed hydroelectric capacity reached 700 MW. |
| 1897 | Canadian branch of Westinghouse established at Hamilton. | 1910 | First 110-kV transmission line built from Niagara Falls to Dundas, Ontario. |
| 1897 | First long-distance, high-voltage transmission line (11 kV) carried power from St. Narcisse, to Trois-Rivières, Quebec - a distance of 29 km. | 1910 | Quebec Streams Commission established. |
| 1898 | Shawinigan Water & Power Company incorporated in Quebec. | 1911 | Calgary Power Co. Ltd. registered on March 17. |
| 1898 | Royal Electric generated 15 MW at Chambly for transmission 26 km to Montreal. | 1918 | New Brunswick Electric Power Commission created. |
| 1900 | Hydroelectric power distributed in all provinces except Prince Edward Island and Saskatchewan. | 1918 | Maritime Electric Company established. |
| 1900 | Montreal Light, Heat & Power Company formed. | 1919 | Ernest Rutherford of McGill University achieved atomic fission. |
| 1900 | Canada's installed hydroelectric capacity reached 133 MW. | 1919 | Manitoba Power Commission established. |
| 1901 | Yukon Electrical Company Limited founded. | 1919 | Nova Scotia Power Commission established. |
| 1901 | Trans-Atlantic wireless demonstrated from Newfoundland by Marconi. | 1921 | Sir Adam Beck No.1 generating plant opened in Niagara Falls, then the largest in the world. Total capacity installed by 1924 was 528 MW. |
| 1902 | Edmonton Electric Light & Power Company becomes a municipal utility. | 1924 | Newfoundland Light & Power Company established. |
| 1902 | Shawinigan aluminium plant produced conductors for the Shawinigan-Montreal transmission line. | 1928 | World's first 10 000 kW, 3 600 rpm steam-driven turbo generator installed at Edmonton Power's Rosedale generating station. |
| 1903 | Shawinigan Water & Power installed the world's largest generator (5,000 hp) and transmitted power over the world's longest and highest voltage line -136 km to Montreal at 50 kV. | 1929 | Saskatchewan Power Commission formed. |
| | | 1930 | Canada's installed generating capacity reached 4700 MW. |
| | | 1940 | The Canadian Standards Association assumed responsibility for approvals testing of electrical equipment. |
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- 1944 Hydro-Québec formed; acquired the facilities of the Montreal Light, Heat and Power Company.
 - 1948 Northern Canada Power Commission created.
 - 1949 Manitoba Hydro-Electric Board established.
 - 1951 First 100-MW thermal generating unit installed.
 - 1954 Newfoundland and Labrador Hydro created.
 - 1956 First 315-kV transmission lines energized to carry power from Bersimis No.1 in northeastern Quebec to Quebec City and Montreal.
 - 1956 First tie-line between Manitoba and Ontario enters service for the interchange of power. The Seven Sisters-Kenora transmission line connected the northwestern system of Ontario Hydro and the southern system of Manitoba Hydro.
 - 1957 Edmonton Power is the first Canadian utility to utilize a high-voltage (72 kV) high-pressure oil-filled pipe cable system.
 - 1957 First Canadian pumping/generating station (capacity 177 MW) enters service at Niagara Falls.
 - 1958 Great Lakes Power Company installed highest head (34 m) variable pitch blade Kaplan turbine in North America.
 - 1960 Beauharnois (Quebec) first generating station to exceed 1000 MW installed. By 1986, installed capacity at this station reached 1639 MW.
 - 1961 Largest single generating unit in Canada (300 MW) begins producing electricity at Ontario Hydro's Lakeview generating station.
 - 1962 Saskatchewan Power installed first 25-kV underground residential distribution system.
 - 1962 B.C. Hydro acquired the B.C. Electric Company.
 - 1963 Hydro-Québec acquired private power companies, including Shawinigan Water & Power.
 - 1963 Ratification of the Columbia River Treaty by Canada and the U.S. allowed B.C. Hydro to proceed with the construction of the Duncan, Keenleyside and Mica dams.
 - 1965 First 735-kV transmission line from Manicouagan-Outardes to the Quebec load centres energized. At the time, it was the highest A.C. voltage in commercial use in the world.
 - 1966 Development of the hydroelectric potential of the Nelson River in northern Manitoba begins.
 - 1967 First commercial-scale (220 MW) CANDU nuclear generating station in service at Douglas Point, Ontario.
 - 1967 Ontario Hydro completes a 696-km, 500-kV transmission line from the Mattagami - Abitibi complex to Toronto.
 - 1968 Power from Peace River transmitted to the B.C. lower mainland via a 918-km, 500-kV line.
 - 1968 First Canadian DC transmission in service between Vancouver Island and the mainland at 260 kV.
 - 1969 First 500-MW thermal generating unit operating at Lambton, Ontario.
 - 1971 First two of four 542-MW nuclear generating units commissioned at Pickering, Ontario.
 - 1971 First two units (500 MW and 475 MW) of the Churchill Falls, Labrador, hydroelectric station commissioned.
 - 1971 Alberta Power established as the operating company for all of Canadian Utilities Limited's electric operations.
 - 1972 World's largest solid-state high-voltage, direct-current (HVDC) converter/inverter terminal (320 MW) placed in service at Eel River, New Brunswick.
 - 1972 An 880-km, 450-kV HVDC long-distance transmission system placed in commercial operation from the Nelson River to Winnipeg.
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| <p>1973 Nova Scotia Power Commission became Nova Scotia Power Corporation, incorporating Nova Scotia Light & Power Company.</p> <p>1974 Completion of the Churchill Falls generating station, with a total capacity of 5429 MW.</p> <p>1974 Kettle hydro generating station, Manitoba Hydro's first generating station to be developed on the lower Nelson River, completed with a total capacity of 1272 MW.</p> <p>1976 First 825-MW unit of the Bruce nuclear generating complex commissioned. (Total capacity of the complex is now 6600 MW.)</p> <p>1978 New Brunswick-P.E.I. 100-MW submarine cable interconnection placed in service.</p> <p>1979 First four 333-MW units of the LG 2 (James Bay) hydroelectric station placed in service by Hydro-Québec. (Total station capacity is 5328 MW, achieved by 1981.)</p> <p>1983 A process to remove low-level PCBs from mineral oil is developed by Ontario Hydro.</p> | <p>1983 Point Lepreau No.1 nuclear power unit (680 MW) placed in service by N.B. Power at Point Lepreau, New Brunswick.</p> <p>1984 First tidal power generating plant in North America placed in service by Nova Scotia Power at Annapolis Royal, Nova Scotia.</p> <p>1986 TransAlta Utilities and B.C. Hydro commission 500-kV interconnection.</p> <p>1986 The last unit (Unit 8) of Ontario Hydro's Pickering B nuclear station declared in service.</p> <p>1987 Formation of the Yukon Energy Corporation.</p> <p>1988 SaskPower completes the Athabasca transmission line, the longest line in its system. The 115-kV line stretches 355 km from near Uranium City to Rabbit Lake.</p> <p>1988 Formation of the Northwest Territories Power Corporation.</p> |
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B2. Chronology of Regional Interconnections

Interconnection	Voltage (kV)	Date-in-Service
Quebec-Ontario	230	1928
Quebec-Ontario	115	1930 ⁽¹⁾
Quebec-Ontario	230	1932
Quebec-Ontario	115	1933 ⁽¹⁾
Quebec-Ontario	115	1940 ⁽¹⁾
Quebec-Ontario	230	1941
Quebec-Ontario	115	1942
Quebec-Ontario	115	1949
Quebec-Ontario	115	1949
Manitoba-Ontario	115	1956 ⁽²⁾
Manitoba-Saskatchewan	230	1960 ⁽³⁾
New Brunswick-Nova Scotia	138	1961
New Brunswick-Nova Scotia	138	1965
Quebec-New Brunswick	69	1965
Quebec-Ontario	115	1966
Quebec-Ontario	115	1966
Western Ontario-Eastern Ontario	230	1969
Labrador-Quebec	735	1971
Labrador-Quebec	735	1972
Western Ontario-Eastern Ontario	230	1972
Manitoba-Saskatchewan	230	1972
Manitoba-Saskatchewan	110	1981 ⁽⁶⁾
Manitoba-Saskatchewan	110	1981 ⁽⁶⁾
Manitoba-Ontario	230	1972
Quebec-New Brunswick	+80 (DC)	1972
Quebec-New Brunswick	230	1972
Manitoba-Ontario	230	1973
Labrador-Quebec	735	1973
Alberta-British Columbia	138	1973
New Brunswick-Nova Scotia	345	1976 ⁽⁴⁾
New Brunswick-Prince Edward Island	138	1977 ⁽⁵⁾
New Brunswick-Prince Edward Island	138	1977 ⁽⁵⁾
Manitoba-Saskatchewan	230	1979
Manitoba-Saskatchewan	110	1981 ⁽⁶⁾
Manitoba-Saskatchewan	110	1981 ⁽⁶⁾
Alberta-British Columbia	500	1985
Quebec-New Brunswick	+80 (DC)	1985
Quebec-New Brunswick	345	1985

Notes: (1) 230 kV construction.
 (3) Operated at 138 kV until 1968.
 (5) Submarine cable.

(2) Constructed in 1931; interconnected in 1956.
 (4) Operated at 138 kV until 1979.
 (6) Constructed in 1930. Purchased by SaskPower from Churchill River Power Company in 1981.

All interconnections are alternating current (AC), except for the Quebec-New Brunswick direct current (DC) facilities.
 All Quebec-Ontario interconnections and both Quebec-New Brunswick AC interconnections are radial
 (i.e. between one system and an isolated section of the other system).

APPENDIX C

C1. Remaining Hydroelectric Potential in Canada

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Remaining Hydroelectric Potential in Canada*

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
NEWFOUNDLAND				
Gull Island	1698	1698	1698	76
Muskrat Falls	618	618	618	87
Lobstick	160	160	-	71
Pinware	77	77	-	67
Alexis	98	98	-	72
Paradise (Lab.)	89	89	-	66
Minipi	255	255	-	76
Fig	204	204	-	77
Eagle River	661	661	-	71
Naskaupi	290	290	-	73
Kaniriktok	394	394	-	75
Granite Canal	31	31	31	80
Island Pond	30	30	30	70
Round Pond	18	18	18	84
Sub Total	4623	4623	2395	
OTHER SITES				
10 MW	186	-	-	61
<10 MW	392	-	-	61
TOTAL ALL SITES	5201	4623	2395	
NOVA SCOTIA				
10 MW	75	75	-	28
<10 MW	15	15	-	54
Sub Total	90	90	-	
TIDAL				
Cumberland Basin	1428	1428	-	26
Minas Basin	5338	5338	-	31
Shepody Bay	1643	1643	-	25
TOTAL ALL SITES	8499	8499	-	
NEW BRUNSWICK				
Grand Falls (Ext)	300	300	300	21
Morrill	140	140	140	35
Green River	160	160	-	7
Other sites	340	-	-	61
TOTAL ALL SITES	940	600	440	

Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
QUEBEC				
LG-1	1 312	1 312	1 312	64
Laforge-1	817	817	817	59
Brisay	382	382	382	68
Eastmain-1	510	510	510	63
Eastmain-2	200	200	-	74
Ste-Marguerite	822	822	822	58
Grande Baleine	2 891	2 891	2 891	60
Ashuapmushuan	776	550	550	75
NBR	8 700	8 700	8 700	61
Nastapoca	768	768	-	59
Sakami	187	187	-	79
La Romaine	1 710	1 710	1 710	59
Laforge-2	270	270	270	72
Haut St-Maurice	700	700	-	64
Matawin	212	212	-	75
Outaouais Sup.	281	281	-	45
Rapide-Manigance	78	78	-	88
Temiscamingue	195	195	-	53
Toulousteouc	71	71	-	48
Aguanus	329	329	-	79
Magpie	354	354	-	79
Moisie	1 014	1 014	-	79
Musquaro	86	86	-	78
Natashquan	703	703	-	79
Olomane	300	300	-	80
Petit-Mecatina	1 754	1 754	-	59
St-Augustin	66	66	-	59
St-Paul	157	157	-	53
A-la-Baleine	807	807	-	78
Arnaud-Payne	592	592	-	67
Aux-Feuilles	711	711	-	80
Caniapiscou	2 240	2 240	-	81
Eau-Claire	321	321	-	60
George	2 826	2 826	-	80
Harricana	1 032	1 032	-	80
Archipel	418	418	-	93
Other Ident. Sites	5 200	5 200	-	61
OTHER SITES	4 800	-	-	61
Sub total	44 592	39 566	17 964	
TIDAL	26 416	-	-	25
TOTAL ALL SITES	71 008	39 566	17 964	

Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
ONTARIO				
Long Sault Rapids	52	52	52	52
Abitibi Canyon (Ext)	463	463	463	3
Newpost Creek	26	26	-	76
Otter Rapids (Ext)	174	174	174	3
Nine Mile Rapids	295	295	295	28
Sand Rapids	131	131	-	31
Allan Rapids	131	131	-	31
Ear Falls (Ext)	15	15	15	37
Maynard Falls	51	51	51	52
Little Jackfish	132	132	132	49
Highland Falls	94	94	-	18
Farm Rapids	13	13	-	52
Coral Rapids	192	192	-	19
Blacksmith Rapids	140	140	-	30
Upper Ten Mile Rapids	16	16	-	67
Yellow Falls	54	54	54	26
Cypress Falls	42	42	42	29
Little Long (Ext)	61	61	61	13
Smoky Falls (Redev)	182	182	182	32
Harmon (Ext)	68	68	68	16
Kipling (Ext)	68	68	68	16
Grand Rapids	174	174	174	41
Thunderhouse Falls	42	42	-	48
Long Rapids	126	126	-	44
Mileage 66	81	81	-	40
Mileage 25	80	80	-	40
Patten Post	250	250	250	17
Ragged Chute (Redev)	98	98	98	21
Grey Goose	140	140	140	48
Renison	135	135	135	47
Adam Beck (Ext)	550	550	550	30
Paquette Rapids	29	29	-	89
Manitou Falls	58	58	-	17
Marathon	65	65	-	18
Spanish Site 4	80	80	-	38
Spanish Site 1	40	40	-	38

Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
ONTARIO (continued)				
Denison Falls	36	36	-	29
Chicagouse Falls	28	28	-	38
Lower Ten Mile Rapids	19	19	-	67
Umbata Falls	51	51	-	40
Chigamiwingum Falls	57	57	-	41
Matabitchuan (Redev)	73	73	-	12
Alexander (Ext)	19	19	-	11
Cameron (Ext)	18	18	-	11
Pine Portage (Ext)	28	28	-	4
Chat Falls (Ext)	20	20	-	23
Chenaux (Ext)	196	196	-	5
Des Joachims (Ext)	348	348	-	5
Otto Holden (Ext)	203	203	-	3
Chaudière Falls (Redev)	72	72	-	66
Lake Temiscaming	24	24	-	73
Sub total	5 540	5 540	3 004	
OTHER SITES				
>10 MW	5 480	5 480	360	53
< 10 MW	1 365	1 365	660	66
TOTAL ALL SITES	12 385	12 385	4 024	

Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
MANITOBA				
Conawapa	1 240	1 240	1 240	64
Gillam Island	1 000	1 000	1 000	65
Gull	650	650	650	64
Birthday	450	450	450	69
Red Rock	220	220	220	67
Whitemud	280	280	280	61
Granville Falls	150	150	150	61
First Rapids	190	190	190	78
Manasan	260	260	260	70
Wuskwatim	330	330	330	69
Notigi	100	100	100	68
Kelsey (Ext)	220	220	220	26
Sub total	5090	5090	5090	
OTHER SITES				
>10 MW	3000	-	-	61
< 10 MW	100	-	-	61
TOTAL ALL SITES	8190	5090	5090	
SASKATCHEWAN				
Island Falls (Ext)	100	100	35	70
Wintego	285	285	285	60
Choiceland	150	150	150	40
Forks	400	400	400	40
Sub total	935	935	870	
OTHER SITES	1254	-	-	60
TOTAL ALL SITES	2189	935	870	

Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
ALBERTA				
Berland	71	71	-	61
McLeod	36	36	-	61
McLeod Valley	22	22	-	61
Pembina	12	12	-	61
Cardinal	3	3	-	61
Elk	25	25	-	61
Frontal	19	19	-	61
Isaak	18	18	-	61
Job	4	4	-	61
Olympus	11	11	-	61
Race	8	8	-	61
Southesk Diversion	21	21	-	61
Strike	27	27	-	61
Thistle	25	25	-	61
Thunder	19	19	-	61
Horseguard	1	1	-	61
Brazeau Forks	88	88	-	61
Carvel	135	135	-	61
Chambers Creek	47	47	-	61
Drayton Valley	162	162	-	61
Gap	91	91	-	61
Hairy Hill	182	182	-	61
Phoenix	80	80	-	61
Ramparts	122	122	-	61
Rocky Mountain	49	49	-	61
Shunda	48	48	-	61
Whirlpool	10	10	-	61
Magnolia	7	7	-	61
Vermillion	12	12	-	61
Carcajou	1329	1329	-	61
Dunvegan	256	256	256	61
Mile 232	898	898	-	61
Mile 251	1011	1011	-	61
Vermillion Chutes	75	75	-	61
18th Baseline	210	210	-	61
19th Baseline	337	337	-	61
Bolton	124	124	-	61
Cutbank	174	174	-	61
Kakwa	346	346	-	61
Meander	292	292	-	61
Peace River	253	253	-	61
Sulphur	84	84	-	61

 Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
ALBERTA (continued)				
Wapiti	228	228	-	61
Watino	346	346	-	61
West Watino	318	318	-	61
Dickson	7	7	-	61
Raven Dam Site	7	7	-	61
Alternative 4	1667	1667	1667	61
Bassano	1	1	-	61
Cochrane	19	19	-	61
Dalemead	112	112	-	61
Eyremore	17	17	-	61
Glenbow	29	29	-	61
Lac des Arcs	15	15	-	61
Radnor	21	21	-	61
Russell	41	41	-	61
Shepard	78	78	-	61
Castle Site (1978)	7	7	-	61
Brocket	14	14	-	61
Fort MacLeod	7	7	-	61
Three Rivers	25	25	-	61
Meridan	45	45	-	61
Rapid Narrows	14	14	-	61
Sub total	9 762	9 762	1 923	
OTHER POTENTIAL	9 051	-	-	61
TOTAL ALL SITES	18 813	9 762	1 923	

Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
BRITISH COLUMBIA				
Peace Site C	900	900	900	60
Keenleyside	240	240	240	55
Murphy Creek	275	275	275	60
Stikine-Iskut	2 900	2 900	2 900	61
Liard River	4 318	4 318	3 190	66
Falls River (Redev)	15	15	15	36
Seven Mile Unit 4	202	202	202	16
Homathko	895	895	710	55
Elaho	340	340	340	70
Border	250	250	250	74
McGregor Lower Canyon	360	360	360	62
Kemano Completion	520	520	520	60
Waneta (Ext)	380	380	380	28
Brilliant (Ext)	150	150	150	44
Shuswap	55	55	55	89
Beatrice Lake	31	31	31	68
Goat River	12	12	12	26
Peace Site E	600	600	-	53
Skeena	1 300	1 300	-	53
Yukon-Taku	3 700	3 700	-	67
Thorsen Creek	3	3	-	53
Duncan	25	25	25	48
OTHER SITES	14 969	-	-	61
Sub total	32 440	17 471	10 555	
TIDAL				
Observation Inlet	660	660	-	35
Sechelt Inlet	54	54	-	35
TOTAL ALL SITES	33 154	18 185	10 555	

Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
YUKON				
Mid Yukon	480	480	-	66
Hootalinqua	259	259	-	75
Wolverine	476	476	-	75
Detour Canyon	100	100	-	60
High Granite (III)	414	254	-	75
Braden Canyon	150	150	-	60
Big Salmon	301	301	-	75
Bell/Porcupine River	110	110	-	60
Frances, Upper Canyon	58	-	-	60
Frances, False Canyon	170	58	58	60
Frances, Lower Canyon	80	75	75	60
Liard Basin	244	244	-	60
Liard Canyon	90	90	90	60
Aberdeen Falls	300	300	-	60
Bonnet Plumi	198	198	-	65
Porcupine Canyon	190	190	-	65
Porcupine Diversion	1 241	1 241	-	65
Porcupine/Stewart	83	83	-	60
Slate Rapids	42	42	42	60
Fraser Falls	300	300	-	60
Independence	450	450	-	60
Hoole Canyon	40	40	40	60
Hoole River	15	15	15	60
Ross Canyon	30	30	30	60
Primrose	30	30	-	60
Five Finger Rapids	455	150	-	75
Yukon-Taku	3 692	1 500	-	85
Yukon-Yaiya	4 050	2 000	-	85
Pelly Basin	160	160	-	60
Stewart Basin	150	150	-	60
Upper Canyon/White	16	16	-	60
Lower Canyon/White	16	16	-	60
Kluane Canyon	17	17	-	60
Britannia	459	459	-	75
Tatshenshine (I&II)	160	160	-	60
Donjek	43	43	-	60
Bates Canyon	110	110	-	60
Peel Diversion	755	755	-	65
Ogilvie	896	896	-	75
Dawson	571	571	-	75
Boundary	1 006	1 006	-	75
NWPI	55	55	-	60
Yukon River Basin	121	121	-	60

Remaining Hydroelectric Potential in Canada* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
YUKON (continued)				
Sub total	18 583	13 701	350	
OTHER SITES	-	-	-	
TOTAL ALL SITES	18 583	13 701	350	
N.W.T.				
Anderson	160	160	-	60
Back	2073	2073	1162	60
Burnside	525	525	-	60
Camsell	29	29	-	60
Coppermine	279	279	149	60
Dubawnt River	178	178	-	60
Ferguson	16	16	-	60
Great Bear 1	438	438	204	60
Great Bear 2	414	414	-	60
Hornaday	91	91	-	60
Horton	115	115	-	60
Hayes	120	120	-	60
Hood	52	52	-	60
Kakisa	21	21	13	60
Kazan	64	64	-	60
Maguse	39	39	-	60
Nahanni/Virginia	232	232	216	60
Nahanni	339	339	-	60
Flat	18	18	-	60
Lockhart	387	387	126	60
Pikes Portage	148	148	126	60
Quoich	207	207	-	60
Tha-Anne	41	41	-	60
Taltson	113	113	34	60
Tazin	15	15	-	60
Thelon	188	188	34	60
Thlewiaza	73	73	-	60
Trout	10	10	6	60
Slave	1130	1130	370	60
Sylvia Grinnell	86	86	6	60
Snowdrift	6	6	-	60
Arctic Red	80	80	-	60
Peel	200	200	-	60

REMAINING HYDROELECTRIC POTENTIAL IN CANADA* (continued)

Sites	Gross Potential ¹ (MW)	Identified Potential ² (MW)	Planning Potential ³ (MW)	Capacity** Factor (%)
N.W.T. (continued)				
Rat	450	450	-	60
Keele	75	75	-	60
Mountain	70	70	-	60
Root	55	55	-	60
Redstone	135	135	-	60
Dahadinni	160	160	-	60
Willow Lake	20	20	-	60
La Martre	27	27	27	60
Armshow	20	20	-	60
Anna Maria Port	7	7	-	60
Ward Inlet	15	15	-	60
Petitot	27	27	-	60
Hanbury	246	246	-	60
Prince	4	4	-	60
Maguse	3	3	-	60
Sub total	9 201	9 201	2 473	
OTHER SITES	28	-	-	60
TOTAL ALL SITES	9 229	9 201	2 473	
CANADA TOTAL	188 191	121 467	46 084	

* Estimated.

1 Gross Potential - The total gross resource that could be developed if there were no technical, economic or environmental constraints (excludes sites already developed or under construction).

2 Identified Potential - Gross potential less sites that may not be developed for technical reasons.

3 Planning Potential - Identified potential less sites that may not be developed for environmental or economic reasons. The planning potential thus comprises all those sites that are considered to be likely candidates for future development.

** Capacity factors have been rounded off. In some cases, capacity factors have been estimated using 61 per cent for hydro and 25 per cent for tidal.

Ext Extension.

Redev Redevelopment.

Source: Canadian electric utilities and Energy, Mines and Resources Canada.

DEFINITIONS AND ABBREVIATIONS

Alternating Current (AC): A current that flows alternately in one direction and then in the reverse direction. In North America the standard for alternating current is 60 complete cycles each second. Such electricity is said to have a frequency of 60 hertz. Alternating current is used universally in power systems because it can be transmitted and distributed much more economically than direct current.

Base Load: The minimum continuous load over a given period of time.

British Thermal Unit (BTu): A unit of heat. The quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

Capacity: In the electric power industry, capacity has two meanings:

1. **System Capacity:** The maximum power capability of a system. For example, a utility system might have a rated capacity of 5000 megawatts, or might sell 50 megawatts of capacity (i.e. of power).
2. **Equipment Capacity:** The maximum power capability of a piece of equipment. For example, a generating unit might have a rated capacity of 50 megawatts.

Capacity Factor: For any equipment, the ratio of the average load during some time period to the rated capacity.

Cogeneration: A cogenerating system produces electricity and heat in tandem. Such systems have great potential in industry, where a significant requirement for electricity is coupled with a large demand for process steam.

Consumer Price Index (CPI): A measure of the percentage change over time in the cost of purchasing a constant "basket" of goods and services. The basket consists of items for which there are continually measurable market prices, so that changes in the cost of the basket are due only to price movements.

Consumption: Use of electrical energy, typically measured in kilowatt hours.

Conventional Generation: Electricity that is produced at a generating station where the prime movers are driven by gases or steam produced by burning fossil fuels.

DEFINITIONS AND ABBREVIATIONS

Current: The flow of electricity in a conductor. Current is measured in amperes.

Demand Charge: The component of a two-part price for electricity that is based on a customer's highest power demand reached in a specified period, usually a month, regardless of the quantity of energy used (e.g. \$2.00 per kilowatt per month). The other component of the two-part price is the energy charge.

Direct Current (DC): Current that flows continuously in the same direction (as opposed to alternating current). The current supplied from a battery is direct current.

Economy Energy: Energy sold by one power system to another, to effect a saving in the cost of generation when the receiving party has adequate capacity to supply the loads from its own system.

Electrical Energy: The quantity of electricity delivered over a period of time. The commonly used unit of electrical energy is the kilowatt-hour (kW.h).

Electrical Power: The rate of delivery of electrical energy and the most frequently used measure of capacity. The basic unit is the kilowatt (kW).

Energy Charge: The component of a two-part price for electricity which is based on the amount of energy taken (e.g. 20 mills per kW.h). The other component of the price is the demand charge.

Energy Source: The primary source that provides the power that is converted to electricity. Energy sources include coal, petroleum and petroleum products, gas, water, uranium, wind, sunlight, geothermal, and other sources.

Firm Energy or Power: Electrical energy or power intended to be available at all times during the period of the agreement for its sale.

Frequency: The number of cycles through which an alternating current passes in a second. The North American standard is 60 cycles per second, known as 60 hertz.

DEFINITIONS AND ABBREVIATIONS

Gigawatt (GW): One billion watts. (See Watt.)

Gigawatt hour (GW.h): A unit of bulk energy. A million kilowatt hours. A billion watt hours.

Grid: A network of electric power lines and connections.

Gross Domestic Product (GDP): The total value of goods and services produced in Canada. GDP measured in constant dollars is defined as Real GDP.

Gross National Product (GNP): The total value of production of goods and services measured at market prices.

Hertz (Hz): The unit of frequency for alternating current. Formerly called cycles per second. The standard frequency for power supply in North America is 60 Hz.

Installed Capacity: The capacity measured at the output terminals of all the generating units in a station, without deducting station service requirements.

Interruptible Energy or Power: Energy or power made available under an agreement that permits curtailment or interruption of delivery at the option of the supplier.

Joule: The international unit of energy. The energy produced by a power of one watt flowing for one second. The joule is a very small unit: there are 3.6 million joules in a kilowatt hour.

Kilovolt (kV): 1000 volts.

Kilowatt (kW): The commercial unit of electric power; 1000 watts. A kilowatt can best be visualized as the total amount of power needed to light ten 100-watt light bulbs.

Kilowatt hour (kW.h): The commercial unit of electric energy; 1000 watt hours. A kilowatt hour can best be visualized as the amount of electricity consumed by ten 100-watt light bulbs burning for an hour. One kilowatt hour is equal to 3.6 million joules.

DEFINITIONS AND ABBREVIATIONS

Load: The amount of electric power or energy consumed by a particular customer or group of customers.

Load Factor: The ratio of the average load during a designated period to the peak or maximum load in that same period. (Usually expressed in per cent.)

Megawatt (MW): A unit of bulk power; 1000 kilowatts.

Megawatt hour (MW.h): A unit of bulk energy; 1000 kilowatt hours.

Mill: 1/1000 of a dollar.

Net Exports: Total exports minus total imports.

Nuclear Power: Power generated at a station where the steam to drive the turbines is produced by an atomic process, rather than by burning a combustible fuel such as coal, oil or gas.

Peak Demand: The maximum power demand registered by a customer or a group of customers or a system in a stated period of time such as a month or a year. The value may be the maximum instantaneous load or more, usually the average load over a designated interval of time, such as one hour, and is normally stated in kilowatts or megawatts.

Power System: All the interconnected facilities of an electrical utility. A power system includes all the generation, transmission, distribution, transformation, and protective components necessary to provide service to the customers.

Primary Energy Source: The source of primary energy from which electricity is generated. This may be falling water, uranium (by nuclear fission), coal, oil, natural gas, wind, tidal energy, etc.

Reserve Generating Capacity: The extra generating capacity required on any power system over and above the expected peak load. Such a reserve is required mainly for two reasons: (i) in case of an unexpected breakdown of generating equipment; (ii) in case the actual peak load is higher than forecast.

DEFINITIONS AND ABBREVIATIONS

Terawatt Hours (TW.h): One billion kilowatt hours.

Voltage: The electrical force or potential that causes a current to flow in a circuit (just as pressure causes water to flow in a pipe). Voltage is measured in volts (V) or kilovolts (kV). $1 \text{ kV} = 1000 \text{ V}$.

Watt: The scientific unit of electric power; a rate of doing work at the rate of one joule per second. A typical light bulb is rated 25, 40, 60 or 100 watts, meaning that it consumes that amount of power when illuminated. A horse power is 746 watts.
